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Westinghouse  
Hanford Company

Richland, Washington

Hanford Operations and Engineering Contractor for the  
U.S. Department of Energy under Contract DE-AC06-87RL10930

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HAZARDOUS MATERIALS PACKAGING & SHIPPING

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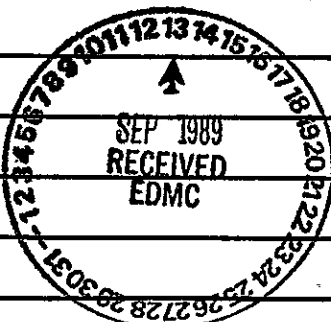
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# Hazardous Material Packaging and Shipping

Procurement and Materials Management

Date Published  
July 1988

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**Westinghouse  
Hanford Company**

P.O. Box 1970  
Richland, Washington 99352

Hanford Operations and Engineering Contractor for the  
U.S. Department of Energy under Contract DE-AC06-87RL10930

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Materials Mgmt

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INTRODUCTION

Approved by

  
D. K. Quigley, Manager  
Procurement and Materials Mgmt

## 1.0 PURPOSE

This manual defines the requirements, responsibilities and procedures necessary to ensure all hazardous material shipments are packaged and transported in a manner that complies with all the appropriate regulations and minimizes risk to employees, the shipping industry, the public and the environment.

## 2.0 SCOPE

This manual delineates to Westinghouse Hanford Company (WHC) personnel requirements and procedures for properly packaging and shipping hazardous materials and wastes both onsite and offsite at Hanford. It incorporates handling, containment and control standards established by Defense Waste Management, Environmental, Safety, Quality Assurance and Security, Resource Allocation and Management and Advanced Reactor Development. This manual further ensures, by summary or by reference, that all hazardous material shipments will be conducted in accordance with:

1. DOE Order 1540.2, "Hazardous Material Packaging for Transport-Administrative Procedures."
2. DOE-RL Order 5480.1, Change 1, Chapter III, "Safety Requirements for the Packaging of Fissile and Other Radioactive Materials."
3. DOE Order 5480.3, "Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances and Hazardous Waste."
4. DOE Order 5630.1, "Control and Accountability of Nuclear Materials."
5. DOE Order 5632.4, "Physical Protection of Security Interests."
6. DOE Order 5700.6B, "Quality Assurance."
7. Code of Federal Regulations, "Energy," 10 CFR, Applicable Parts 0 to 199, current edition. Part 71 "Packaging and Transportation of Radioactive Material."
8. Code of Federal Regulations, Protection of Environment 40 CFR, Applicable Parts, current edition.

## INTRODUCTION

9. Code of Federal Regulations, "Transportation," 49 CFR, Applicable Parts 0 to 199, current edition.
10. Washington State Department of Ecology. Washington Administrative Code, Chapter 173-303WAC Dangerous Waste Regulations, current revision.
11. IATA "Dangerous Goods Regulations," International Air Transport Association, Montreal, Canada, current edition.
12. IAEA Safety Standards, "Regulations for the Safe Transport of Radioactive Materials," Rev. ed., Safety Series No. 6, International Atomic Energy Agency, Vienna, Austria, 1967 and 1973, and later editions as adopted.
13. DOC 9284-AN/905, "Technical Instructions for the Safe Transport of Dangerous Goods by Air." International Civil Aviation Organization, current edition.
14. MLM-3245 (DOE/DP/0053-H1) "DOE Evaluation Document for DOT 7A Type A Packaging" Edling, D.A. et al. March 1987.
15. WHC-CM-1-3 Management Requirements and Procedures, MRP 5.20, "Hazardous Material Packaging and Shipping."
16. WHC-CM-1-3 Management Requirements and Procedures, MRP 5.27, "Movement of Radioactive Material."
17. WHC-CM-4-2, Quality Assurance.
18. WHC-CM-4-10, Radiation Protection.
19. WHC-CM-4-29, Nuclear Criticality Safety.
20. WHC-CM-4-34, Nuclear Material Control and Accountability.
21. WHC-CM-5-16, Nonradioactive Dangerous Waste Packaging and Disposal Requirements.
22. WHC-CM-7-5, Environmental Compliance, current revision.
23. WHC-EP-00063, Radioactive Solid Waste Packaging, Storage and Disposal Requirements.

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HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

Effective Date March 20, 1989  
Organization Procurement and  
Materials Management

TITLE:

Approved by

RESPONSIBILITIES AND PROCEDURES FOR  
ALL HAZARDOUS MATERIAL SHIPMENTS

  
D. K. Quigley, Manager  
Procurement and Materials Mgmt

## 1.0 RESPONSIBILITIES

Westinghouse Hanford Company (WHC) has the responsibility to develop and maintain a comprehensive program for the packaging and transport of all hazardous materials that complies with the minimum requirements identified in Department of Energy (DOE) Order 5480.3 and Department of Energy-Richland (DOE-RL) Order 5480.1, Change 1 supplement, and their referenced documents. Westinghouse Hanford Company will ensure that hazardous materials are prepared, packaged and transported in a safe manner that will not present a hazard to the health and safety of plant personnel or to the public. Onsite packaging and shipping shall be conducted in accordance with the Department of Transportation (DOT) regulations or, if not technically or economically practicable, provide an equivalent degree of safety. Departure from the DOT regulations shall be documented in a Safety Analysis Report for Packaging (SARP) approved by the WHC Approval Authority and DOE-RL, when appropriate.

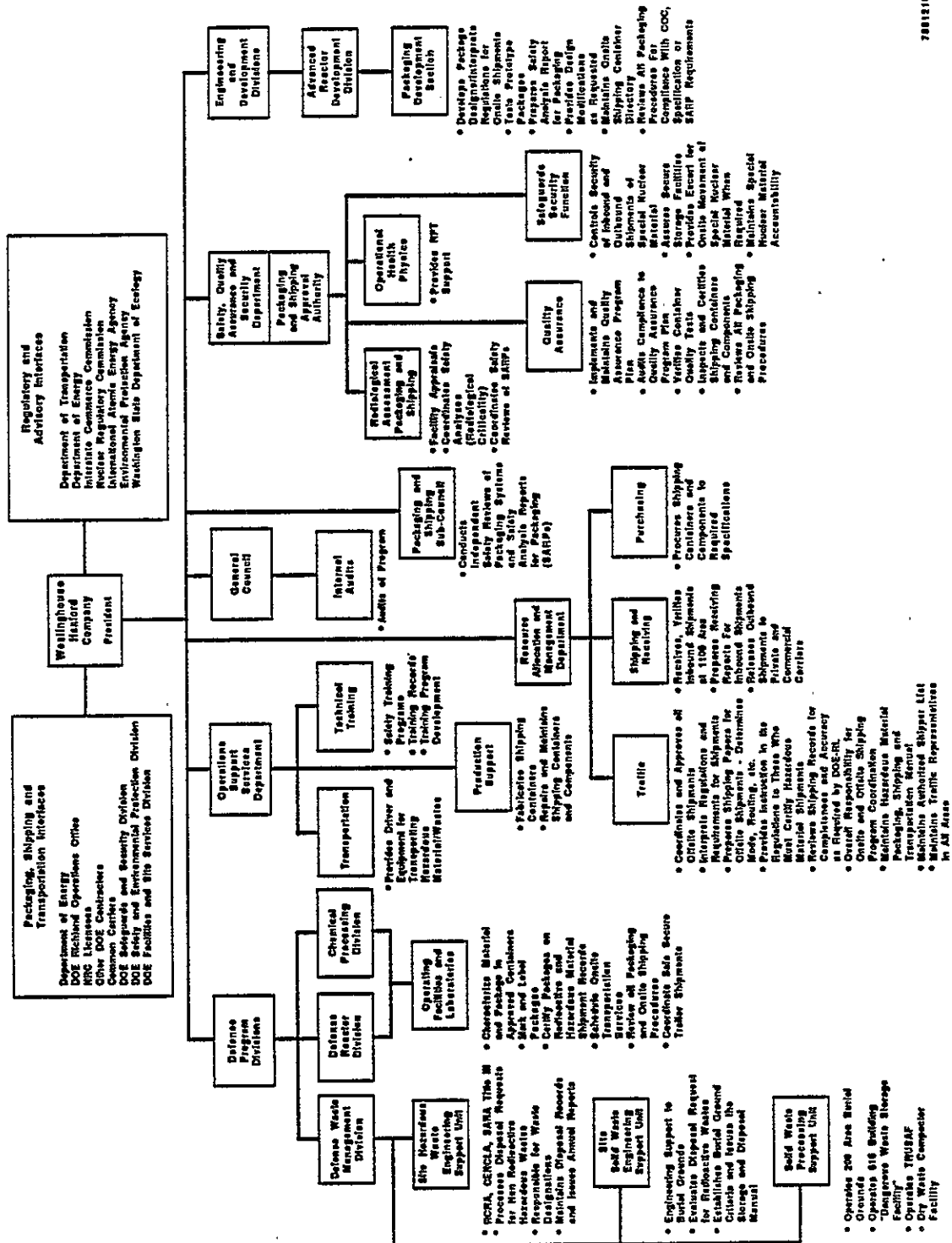
The group responsibilities defined to carry out the hazardous material packaging and shipping program commitment are shown below and summarized in Figure II-1-1.

### 1.1 PROCUREMENT AND MATERIALS MANAGEMENT

Procurement and Materials Management (PMM), a Function of Resource Allocation and Management, is assigned overall responsibility for supervising implementation of, and compliance with, WHC-CM-1-1, Management Policies, MP 2.5, "Shipping and Receiving", which includes overall guidance for implementing and maintaining the shipping and receiving program, both onsite and offsite, through development and maintenance of implementing procedures and manuals.

#### 1.1.1 Traffic

1. Provides overall management responsibility of inbound and outbound offsite shipments of hazardous materials.
2. Responds to DOE-RL inquiries concerning the overall packaging and shipping program.
3. Obtains formal interpretation of transportation regulations from the appropriate Federal agencies through DOE-RL.

RESPONSIBILITIES AND PROCEDURES FOR  
ALL HAZARDOUS MATERIAL SHIPMENTSHazardous Material Packaging, Shipping and Transportation  
Interfaces and Internal Responsibilities

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Figure II-1-1. Hazardous Material Packaging, Shipping and Transportation Interfaces and Internal Responsibilities.

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4. Verifies compliance with Federal regulations, DOE Orders, and company requirements of all inbound and outbound offsite shipments of hazardous materials for the Hanford Site. Traffic is the only authorized shipper for all offsite hazardous material shipments.
5. Performs a pre-release inspection of each outbound shipment including a review of the shipping records for compliance with DOE and other Federal regulations, requirements, and directives relative to the classification, description, packaging, marking, labeling, and tiedown of containers and certifying to the carrier that such containers leaving the Hanford Site are in proper condition for transport.
6. Maintains a working file of Certificates of Compliance (COCs) and Safety Analysis Reports for Packaging (SARPs) for radioactive material Containers used by Hanford contractors. Reviews the COC and SARP applicable to each container packaged for offsite shipment for quantity and type of material authorized and the certificate expiration date.
7. Provides temporary storage in the 1100 Area for certain inbound and outbound offsite shipments.
8. Reviews Hanford Site intra and interarea radioactive shipment records to ensure compliance with applicable regulations.
9. Prepares formal training courses, and provides instruction to qualify personnel in the proper procedures for authorizing/certifying hazardous material shipments in accordance with DOT, DOE, United States Environmental Protection Agency (EPA), and Washington State regulations.
10. Prepares and maintains the Hazardous Material Packaging and Shipping Manual.
11. Prepares and revises MRP 5.20, "Packaging and Transportation of Hazardous Materials" as required.
12. Provides operational overview of onsite shipping activities. This includes providing area representatives to assist onsite facilities in meeting shipping requirements. The area representative will assist in package selection and procurement, job planning, on the job training, shipment documentation and other related tasks. The area representative will perform reviews of shipping operations and make recommendations for improvements to facility management.

NOTE: In performance of the PMM shipping and receiving duties for Westinghouse and other Hanford Contractors, Traffic works closely with Materials Management to assure smooth operation. The Materials Management responsibilities in performing its part are defined in

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the Materials Management Manual, WHC-CM-2-2 and will not be repeated here. However, because of the various shipping and receiving activities, disbursement of hazardous materials plantwide and the close involvement with Traffic, the interactions between Materials Management and Traffic are detailed in Part V of this manual.

## 1.2 OPERATING ORGANIZATIONS

The Operating organizations include any group that uses, processes, generates or transports hazardous materials. They are responsible to do the following:

1. Manage onsite WHC shipments of hazardous material originating at the operating facilities, and make shipments in compliance with requirements and procedures established in this manual.
2. Coordinate with Traffic, all planned inbound and outbound offsite shipments of hazardous materials, including radioactive materials.
3. Prepare written operating procedures incorporating SARP requirements to be used for the packaging, loading, transportation and unloading of hazardous materials.
4. Package, load, transport and unload hazardous materials in approved packagings, as specified by approved procedures and instructions.
5. Transport repetitive onsite shipments incidental to production, such as samples and waste, on vehicles assigned to the operating organizations.
6. Request preparation of SARPs.
7. Ensure only appropriately trained and qualified personnel are used to inspect, load, monitor, certify, authorize or transport hazardous material packages.
8. Inspect, visually, the vehicle used to transport hazardous material for obvious defects and the vehicle inspection tags to assure the Class A/B preventative maintenance is current.

## 1.3 SAFETY

1. Provides radiation monitoring support for all WHC hazardous material packaging and transportation activities.
2. Ensure ALARA practices are utilized in the packaging and shipment of radioactive material.

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3. Provides radiological and criticality analysis when required for the preparation of SARPs.
4. Reviews and approves Nuclear Criticality Specifications, when required.
5. Performs an annual appraisal of WHC hazardous materials packaging and transportation operations.
6. Reviews and approves applicable WHC documents relating to the packaging and shipment of hazardous materials.
7. Maintains surveillance of packaging and transportation operations to ensure adherence to the technical and safety aspects of the program and provide verification where applicable.

1.4 PACKAGING AND REMOTE SYSTEMS

1. Coordinates and approves all WHC applications for, or amendments to, DOE/U.S. Nuclear Regulatory Commission (NRC) Certificates of Compliance (COC).
2. Prepares and/or evaluates SARP related analyses to assure conformance to applicable regulations, codes, or standards.
3. Assures that all WHC hazardous material packaging systems are designed, developed, tested, approved, and certified in compliance with DOE Orders.

1.4.1 Packaging Development

1. Prepares SARPs for containers used for onsite shipment of radioactive materials.
2. Prepares technical evaluation documentation in accordance with DOE Order 1540.2 for hazardous material packagings including tiedown, content analysis, and DOT certification.
3. Conducts qualification testing of hazardous material packagings to conform to applicable codes, standards, and regulations.
4. Reviews and approves written facility procedures covering onsite radioactive material packaging and transportation activity to assure that all relevant administrative controls related to SARPs, COCs, DOT Exemptions, and Federal/State packaging requirements are properly incorporated.
5. Prepares design criteria and specifications for onsite radioactive material packagings.

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6. Obtains formal interpretations of package design and test criteria from the appropriate Federal agencies through DOE-RL.
7. Responds to inquiries from DOE-RL concerning all package design, testing, evaluation or approval activities.
8. Prepares and maintains the Radioactive Material Shipping Container Directory.

**1.5 SAFEGUARDS AND SECURITY**

1. Establishes security requirements for onsite shipments of radioactive material including special nuclear material (SNM) shipments in accordance with MRP 5.27, "Movement of Radioactive Material".
2. Establishes requirements for nuclear material accountability procedures.

**1.6 PACKAGING AND SHIPPING SUBCOUNCIL (PSSC)**

The PSSC of The Safety and Environmental Advisory Council is chartered in WHC-CM-1-2, Organization Charts and Charters, CH-CC-5.

1. Provides multi-disciplined review and support of ongoing nuclear, environmental, safety, and safeguards and security matters associated with packaging and shipping activities involving radioactive, hazardous, extremely hazardous and dangerous materials.
2. Provides review for:
  - a. All SARP's.
  - b. Significant changes to administrative controls and modifications to containers or casks.
  - c. Periodic updates of onsite Hazardous Material Packaging and Shipping Manual.
3. Recommends approval of reviewed documentation and designs to the WHC Approval Authority.

**1.7 APPROVAL AUTHORITY**

The Manager, Safety approves certain actions of the PSSC based on its recommendations.

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## **1.8 QUALITY ASSURANCE**

1. Assists in the development, implementation, and maintenance of a Quality Assurance Program for the packaging and transportation of hazardous material which addresses the fabrication, testing, assembly, maintenance, repair and use (including reuse) of approved packagings.
2. Reviews and approves WHC Impact Level 1, 2, and 3 shipping container procurement documentation to ensure compliance with applicable WHC and DOE requirements.
3. Reviews and approves WHC Impact Level 1, 2, and 3 plans, facility procedures, SARPs, drawings, and specifications related to hazardous material packaging and transportation.
4. Inspects shipping containers procured from outside sources, and those fabricated onsite, including the verification of container qualification tests.
5. Inspects reusable containers for integrity verification, as required by SARPs.
6. Conducts periodic audits and surveillances to assess program compliance with applicable codes, standards and requirements.

## **1.9 PROCUREMENT**

1. Procures shipping containers requested by WHC operations organizations from approved suppliers.
2. Reviews all procurement requests for shipping containers.

## **1.10 TECHNICAL TRAINING**

1. Provides guidance and assistance in developing training and qualification programs for organizations involved in packaging and transportation of hazardous materials.

## **1.11 DEFENSE WASTE MANAGEMENT**

1. Maintains liaison with non-WHC originators of radioactive waste material shipments and coordinates approvals required to package and transport these materials to WHC for waste burial, interim storage, analysis, or processing.
2. Prepares and maintains manuals that describe packaging requirements for storage and disposal of hazardous waste. (See: WHC-EP-000-63 and WHC-CM-5-16).

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## 1.12 SITE SERVICES

1. Transports hazardous materials shipments, using dedicated or special equipment, in accordance with applicable regulations.
2. Provides qualified vehicle operators who are familiar with their vehicles, tiedown procedures and transportation requirements.
3. Provides well maintained vehicles for transport of hazardous materials that are safe and have current Class A/B preventative maintenance inspections.

## 2.0 PROCEDURES

### 2.1 DELEGATION, TRAINING AND APPROVALS OF SHIPPERS

Authorized shippers are employees delegated by their respective managers to receive appropriate training and assume the responsibility of shipping hazardous materials. Exempt employees with a documented need may become authorized shippers. Nonexempt non-bargaining unit employees with a documented need and the approval of their Level III manager may become authorized shippers.

The responsible Level IV manager may initiate the delegation of an employee as an authorized shipper by submitting a Request for Authority form (BC-9600-169, Figure II-2-1, obtained from Traffic) with approval from Safeguards, Security and Traffic and, in the case of a nonexempt employee, the Level III approval.

On review and approval by Traffic, the prospective shipper is scheduled into the Hazardous Materials Training Course conducted by Traffic. On successful completion of this training, Traffic enters the person's name, payroll number and authorization on a list of approved shippers.

As a minimum, the training for authorized shippers consists of eight hours of formalized instruction in Traffic's "Certification of Hazardous Material Shipments" course, plus a take home exam. Additionally, it is the responsibility of the line manager to assure that the authorized shipper is provided the necessary supplemental training geared to the specific shipping concerns of their facility.

In order to maintain the certification, the shipper should be actively involved in the shipping of hazardous materials. The shipper is required to make at least one onsite radioactive shipment within a six month time period or retake the "Certification of Hazardous Material Shipments" training course examination; otherwise, the shipper's name will be removed from the list of authorized shippers.



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Training requirements for signature authority are as follows:

- o Those who sign Radioactive Shipment Records (RSRs), offsite radioactive shipment records (ORSRs) and Hazardous Material Shipping Records (HMSRs) must complete the "Certification of Hazardous Material Shipments" course. Required every twenty four months.
- o Those who sign the Uniform Manifest must complete the "Hazardous Waste Shipment Certification" course. Required annually.
- o Nuclear material custodians who sign RSRs or ORSRs for Special Nuclear Material (SNM) shipments must also complete the "Nuclear Material Custodian Training" course. Required annually.
- o For course outlines, see Appendix A.


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# HAZARDOUS MATERIAL PACKAGING AND SHIPPING

## RESPONSIBILITIES AND PROCEDURES FOR ALL HAZARDOUS MATERIAL SHIPMENTS

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 <b>Westinghouse Hanford Company</b>	<b>REQUEST FOR AUTHORITY</b> (TO SHIP HAZARDOUS MATERIALS/WASTES)				Date				
Name (Print)	Payroll No.	Organization	Org. Code	Work Location					
TO: <input type="radio"/> Security 3790/300 AREA		<input type="radio"/> Safeguards 2704Z/200 WEST		<input type="radio"/> Traffic 1166/1100 Area					
<b>INSTRUCTIONS</b>	<p>1. Check below one or more responsibilities for which authority is sought and justify each request. Authority to sign Radioactive Shipment Records, Hazardous Material Shipment Records and Uniform Hazardous Waste Manifests contingent upon successful completion of required training listed in Section D.</p> <p>2. Execute a separate form for each employee.</p>								
<p><b>SECTION A. NON-NUCLEAR RADIOACTIVE AND OTHER HAZARDOUS MATERIALS/WASTE</b></p> <p>Authority is requested for candidate, on qualification, to sign as shipper or waste generator the following documents on behalf of Westinghouse Hanford Company.</p> <p> <input type="checkbox"/> Onsite Radioactive Shipment Records (RSR's)  <input type="checkbox"/> Offsite Radioactive Shipment Records (ORSR's)  <input type="checkbox"/> Hazardous Material Shipment Records (HMSR's)  <input type="checkbox"/> Uniform Hazardous Waste Manifests (uniform manifests)         </p>									
<p><b>SECTION B: NUCLEAR MATERIAL AUTHORIZATION</b></p> <p>Authority is requested for candidate, on qualification, to sign, as shipper, source data forms and RSR's to transfer nuclear materials to DOE contractors onsite or offsite as indicated below:</p> <p> <input type="checkbox"/> Onsite  <input type="checkbox"/> Offsite         </p> <p>Nuclear materials are: Source nuclear materials, special nuclear materials, accountable nuclear materials and other materials identified by DOE Order 5630.12 "Control and Accountability of Nuclear Materials."</p>									
<p><b>SECTION C: 1100 AREA RECEIVING PERSONNEL ONLY</b></p> <p>Candidate is a member of Receiving. Authority is requested, on qualification, to receive radioactive material including nuclear material from transport carriers and forward the shipment onsite.</p> <p><input type="checkbox"/> Sign onsite RSR's only (nuclear and non-nuclear).</p>									
<table border="0" style="width: 100%;"> <tr> <td style="width: 60%;"><b>SECTION D TRAINING REQUIREMENTS FOR DELEGATION</b></td> <td style="width: 40%; text-align: center;"><b>Training Verification</b></td> </tr> <tr> <td> <p><u>"CERTIFICATION OF HAZARDOUS MATERIAL SHIPMENTS"</u> Required for those who sign RSR's, ORSR's, and HMSR's</p> <p><input type="checkbox"/> _____ Date Initials</p> <p><u>"HAZARDOUS WASTE SHIPMENT CERTIFICATION"</u> Required for those who sign Uniform Manifests</p> <p><input type="checkbox"/> _____ Date Initials</p> <p><u>"NUCLEAR MATERIAL CUSTODIAN TRAINING"</u> (Required for SECTION B Only) Required for custodians who sign RSR's or ORSR's to ship nuclear materials</p> <p><input type="checkbox"/> _____ Date Initials</p> </td> <td></td> </tr> </table>						<b>SECTION D TRAINING REQUIREMENTS FOR DELEGATION</b>	<b>Training Verification</b>	<p><u>"CERTIFICATION OF HAZARDOUS MATERIAL SHIPMENTS"</u> Required for those who sign RSR's, ORSR's, and HMSR's</p> <p><input type="checkbox"/> _____ Date Initials</p> <p><u>"HAZARDOUS WASTE SHIPMENT CERTIFICATION"</u> Required for those who sign Uniform Manifests</p> <p><input type="checkbox"/> _____ Date Initials</p> <p><u>"NUCLEAR MATERIAL CUSTODIAN TRAINING"</u> (Required for SECTION B Only) Required for custodians who sign RSR's or ORSR's to ship nuclear materials</p> <p><input type="checkbox"/> _____ Date Initials</p>	
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<p><b>JUSTIFICATION</b> (Include reason why authority is required.)</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>									
<p><b>APPROVALS</b></p>									
Manager (level 4 or above) _____			Traffic 1166 Bldg./1100 Area _____						
Safeguards 2704Z/200 West _____			Security 3790/300 Area _____						

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Figure II-2-1. Request for Authority.

## 2.2 RECEIVERS OF HAZARDOUS MATERIAL SHIPMENTS

Receivers of accountable nuclear material must be designated Material Balance Area/Item Control Area (MBA/ICA) custodians or alternates.

For other radioactive material and hazardous material shipments a receiver may be anyone knowledgeable in the receiving group or a designate. The receiver does not have to be an authorized shipper.

Upon receipt of Type B, Fissile or Highway Route Controlled Quantities (HRCQ) radioactive material shipments, the receiver shall notify the sender and sign the receiving papers or the Onsite Radioactive Shipment Record indicating abnormalities, if any. Delay in receipt beyond a reasonable time shall be cause for prompt search for the shipment.

## 2.3 NONCOMPLIANCE PROCEDURES AND VARIANCE REPORTS

Offsite and onsite RSRs are monitored as needed by Traffic for discrepancies. This enables Traffic to evaluate the effectiveness of the training and the strength of the shipping program.

### 2.3.1 Offsite Shipment

Outbound hazardous material shipments, particularly radioactive shipments, are inspected along with their associated shipping documents (e.g., ORSRs) by Traffic before being released to carriers for offsite transport.

If regulatory violations or errors are noted during this inspection, the shipment is held until all deficiencies are corrected.

Minor errors are corrected by Traffic after discussions with the initiating shipper. Subsequently, the shipment is released to the carrier. These errors are documented internally by Traffic.

If more serious violations are observed, the shipper will be contacted to correct the deficiencies. A determination will be made as to whether corrections can be made at Traffic, or whether the shipment must be returned to the shipper's facility for corrective action. All deficiencies must be corrected to the satisfaction of all parties involved before release can be made to the offsite carrier. Violations of this nature are documented internally by Traffic. If such discrepancies persist, a Variance Report (Figure II-2-2) is issued to the shipper with recommendations for resolution. A copy of the Variance Report, along with corrections to the problem are sent to DOE-RL Projects Management Division. Serious violations will be documented on an Event Fact Sheet or Unusual Occurrence Report.

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# HAZARDOUS MATERIAL PACKAGING AND SHIPPING

## RESPONSIBILITIES AND PROCEDURES FOR ALL HAZARDOUS MATERIAL SHIPMENTS

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HAZARDOUS MATERIAL SHIPMENT REGULATIONS VARIANCE REPORT		
Contractor Originating Shipment	Contractors Shipping Representative	Report Number
Subject Shipment: Shipment Date: _____ ORSR/RSR No.: _____		
Variance Report Originated By: _____, Traffic		Date Initiated
The following variance(s) has/have been noted in a review of the Subject Shipment: <div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"> <p><u>Items</u></p> <div style="display: flex; flex-direction: column; gap: 5px;"> <div><input type="checkbox"/> Security Classification, SNM Classification, Escort Requirements</div> <div><input type="checkbox"/> Identification of Shipper, Receiver, Carrier</div> <div><input type="checkbox"/> Description of Radioactive Contents</div> <div><input type="checkbox"/> Curies/Cont and/or Total Curies/Shipment</div> <div><input type="checkbox"/> Grams Fissile Mat/Cont and/or Total Fissile Mat/Shipment</div> <div><input type="checkbox"/> Physical/Chemical Form</div> <div><input type="checkbox"/> Normal/Special Form</div> <div><input type="checkbox"/> Quantity Category/Shipping Category</div> </div> </div> <div style="width: 50%;"> <div style="display: flex; flex-direction: column; gap: 5px;"> <div><input type="checkbox"/> Packaging Description</div> <div><input type="checkbox"/> Container Approval Documentation</div> <div><input type="checkbox"/> Container Labeling/Vehicle Placarding</div> <div><input type="checkbox"/> Tie Down Requirements</div> <div><input type="checkbox"/> Radiation Survey Data</div> <div><input type="checkbox"/> Instructions to Carrier/Receiver's Signature</div> <div><input type="checkbox"/> Certification/Shipment Approval Signature</div> <div><input type="checkbox"/> Other</div> </div> </div> </div>		
<input type="checkbox"/> Yes <input type="checkbox"/> No    Response to DOE-RL Required Response due by _____ Date		Occurrence Report Required <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
Observations/Recommendations <div style="margin-top: 10px;">             1. _____              _____              _____           </div> <div style="margin-top: 10px;">             2. _____              _____              _____           </div> <div style="margin-top: 10px;">             3. _____              _____              _____           </div> <div style="margin-top: 10px;">             4. _____              _____              _____           </div>		
PLEASE SUBMIT LETTER INDICATING CORRECTIVE ACTION TAKEN TO PREVENT RECURRENCE.		
<u>Distribution:</u> 1. Contractor's Shipping Representative 2. DOE-RL STD 3. DOE-RL SQA 4. Traffic File		For Westinghouse shipments additional copies to the following: 1. Facility Manager - Facility originating Shipment

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Figure II-2-2. Hazardous Material Shipment Regulations Variance Report.

### 2.3.2 Onsite Shipment

Traffic conducts an Onsite Radioactive Shipment Record Review Program. This program requires Traffic Area Representatives to review Hanford onsite RSRs and document errors or omissions observed to evaluate trends and revise training as needed. More serious violations are documented in a Variance Report (Figure II-2-2) to the shipper with recommendations for resolution. Copies of the Variance Report and the final resolution are sent to DOE-RL Projects Management Division. Serious violations will be documented on an Event Fact Sheet or Unusual Occurrence Report.

## 2.4 PACKAGING PROCEDURES

The DOE-RL Order 5480.1, Change 1, Chapter III requires written procedures for packaging, loading, transportation and unloading be prepared for all shipments of fissile, Type B and HRCQ of radioactive material by the operating groups. Traffic recommends similar procedures be prepared for limited and Type A quantities also. These procedures should identify user responsibilities to ensure the container is used in accordance with the applicable federal shipping regulations, the container SARP, and the administrative controls for onsite and offsite shipments, as applicable. The procedures should be detailed to the extent to define individual steps involved and serve as a basis for a checklist of the main steps to ensure procedural compliance. These procedures should be reviewed and approved by Packaging Development and QA as appropriate.

## 2.5 TIEDOWN PROCEDURES

The DOT (49 CFR 177.834(a)) requires any container, not permanently attached to a motor vehicle, containing flammable liquid, compressed gas, corrosive material, poisonous material, or radioactive material must be secured against movement within the vehicle under conditions normally incident to transportation.

## 2.6 RADIOACTIVE SHIPMENT CHECKLIST

All onsite and offsite radioactive materials shipments of fissile, Type A and above quantities shall be documented on a Radioactive Shipment Checklist (Figure II-2-3) to show the shipment and the RSR or ORSR are properly completed.

Routine shipments documented with Onsite Routine RSRs (ORRSRs) are exempt from this requirement.

A group may develop its own shipment checklist, if preferred. However, it must embody all the items on Figure II-2-3 and be reviewed by Traffic prior to use.

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# HAZARDOUS MATERIAL PACKAGING AND SHIPPING

## RESPONSIBILITIES AND PROCEDURES FOR ALL HAZARDOUS MATERIAL SHIPMENTS

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Westinghouse Hanford Company		RADIOACTIVE SHIPMENT CHECK LIST				_____ NM Representative _____ Oper. Org. Representative _____ OHP Representative Initials _____																																																																																																																																																																									
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<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="10" style="text-align: left;">DESCRIPTION</th> <th>Yes</th> <th>No</th> <th>N/A</th> </tr> </thead> <tbody> <tr> <td colspan="10">Physical/Chemical form of radioactive material identified on RSR</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Radionuclides and activities for each container and total shipment identified on RSR and containers as appropriate</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Total grams fissile in shipment identified on RSR</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Transport index identified on RSR and each container label</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Shipper/Receiver correctly identified (see note) on RSR and address label of each container</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Irradiated or nonirradiated radioactive material identified on RSR</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Other hazardous constituents identified on RSR</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Fissile class III limitations identified on RSR and each container if required</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Truck properly placarded (4 min.)</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="10">Placards used _____</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>								DESCRIPTION										Yes	No	N/A	Physical/Chemical form of radioactive material identified on RSR										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Radionuclides and activities for each container and total shipment identified on RSR and containers as appropriate										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Total grams fissile in shipment identified on RSR										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Transport index identified on RSR and each container label										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Shipper/Receiver correctly identified (see note) on RSR and address label of each container										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Irradiated or nonirradiated radioactive material identified on RSR										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Other hazardous constituents identified on RSR										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fissile class III limitations identified on RSR and each container if required										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Truck properly placarded (4 min.)										<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Placards used _____																																					
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Date Shipped _____ Authorized Shipper _____ <b>NOTE: Notify receiver of shipment departure and expected time or date of arrival.</b>																																																																																																																																																																															

DOE - Richland WA

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Figure II-2-3. Radioactive Shipment Check List.

## 2.7 ONSITE PACKAGING SYSTEMS

Onsite packaging systems for shipments of radioactive material are conceived and generated to fulfill a need of a user organization.

The DOE-RL Order 5480.1, Change 1, Chapter III requires a SARP to be made for each Type A, Type B, Fissile or HRCQ onsite container.

Packaging Development is responsible for coordinating onsite container design and the preparation of SARPS. The following procedure describes the process, review, and approval requirements for onsite SARPs prepared by WHC.

1. Initiation - A new SARP or a revision to an existing SARP can be requested by a user organization based on programmatic or operational requirements. The request is submitted to the Manager, Packaging Development in writing and includes proper justification and support documentation. Packaging Development makes routine revisions as necessary to reflect policy or regulation changes.
2. Preparation - Packaging Development coordinates the analyses, prepares the SARP, and guides the SARP through the review and approval process, including resolution of review comments and obtaining document approval.
3. Control - In accordance with WP-1.12, Supporting Documents, a unique document number is issued by Engineering Configuration Management. The document numbering system provides an accessible, auditable, and retrievable method to maintain SARP documentation.
4. Review and Approval Cycle - Revised and new SARPs require the following review and approvals:
  - o User (usually Chemical Processing, Defense Waste Management, Environmental Defense Reactor, and Advanced Reactor Development Function Manager.
  - o Manager, Radiological Assessment, Packaging and Shipping.
  - o Manager, Packaging Development.
  - o Chairman, PSSC.
  - o Packaging and Shipping Approval Authority - Manager, Safety, Quality Assurance, and Security Department.
  - o U.S. Department of Energy-Richland Operations only if the container is to be used for large quantity (Highway Route Controlled Quantity - HRCQ) interarea shipment in accordance with DOE Order RL 5480.1, Chapter III.

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5. Approvals for Editorial Changes - Inconsequential editorial corrections to the SARP require only the approval of the Manager, Packaging Development.
6. Utilization - Once the SARP is approved, copies are sent to the affected organizations, including Process Engineering, to incorporate the administrative controls from the SARP into the affected Operating Documents. User organizations must obtain Packaging Development review of all operating procedures which implement SARP administrative controls to ensure that the administrative controls are being implemented in the intended manner.
7. A departure from SARP established criteria or other WHC policy or procedure that offers an equivalent degree of safety to DOT or other Federal regulations can be granted as a "deviation" with appropriate internal approval (for onsite inter- and intra-area shipments). A departure from criteria established by DOT or other Federal regulations is termed a "waiver" or "exemption" and must be approved by DOE (for onsite inter-area, HRCQ shipments). Deviations or waivers to the SARP may be obtained in the following manner.
  - o The organization requesting a waiver or deviation provides a written request, including justification to the Manager, Packaging Development.
  - o A letter requesting the waiver or deviation is prepared by Packaging Development for the Packaging and Shipping Approval Authority, and includes the time period the waiver is to be effective and any administrative control changes. Concurring approvals on the letter include User; Radiological Assessment, Packaging and Shipping; and Packaging Development. The Approval Authority's signature is final approval for the deviation or waiver.
  - o If the waiver involves a large quantity (HRCQ), inter-area shipment, a letter requesting the waiver from DOE-RL is prepared for the Approval Authority's signature.
  - o A copy of the deviation or waiver is transmitted to all those on distribution for the SARP.

Onsite containers currently approved for onsite use are cataloged and described in the Onsite Container Directory, maintained by Packaging Development. New containers are added to the directory as they are developed and approved.



## 2.8 OFFSITE PACKAGING SYSTEMS

All offsite radioactive material packages and their use must comply with the applicable DOT/DOE/NRC regulations. Contents shipped must be in accordance with the authorized contents section of either the appropriate DOE/NRC COC for licensed containers or the 49 CFR references for specification containers.

Only a few radioactive material containers are regularly used by WHC, but for other containers for special shipments arrangements may have to be made with the container owners as to availability and use. Radioactive material specification containers are listed in 49 CFR. Containers licensed (those with COCs) by NRC and/or DOE are listed in NUREG-0383 "Directory of Certificates of Compliance for Radioactive Materials Packages" and "Directory of DOE Certificates of Compliance for Radioactive Materials Packaging."

Before WHC may use a COC container, they must apply through the local DOE-RL to be listed as a user of that container. The user must have in his possession a copy of the COC for the package and have the drawings and other documents referenced in the COC relating to the use and maintenance of the packaging.

## 3.0 REFERENCES

1. DOE Order 5480.3, "Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes."
2. DOE-RL Order 5480.1, "Environmental Protection, Safety and Health Protection Program for RL" (Chapters III and VI only).
3. WHC-CM-1-1, Management Policies, MP 2.5, "Shipping and Receiving."
4. WHC-CM-1-2, Organization Charts and Charters, CH-CC-5, "Safety and Environmental Advisory Council."
5. WHC-CM-1-3, Management Requirements and Procedures, MRP 5.20, "Packaging and Transportation of Hazardous Materials."
6. WHC-CM-2-2, Materials Management Manual.

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Page 1 of 12  
Effective Date August 1, 1988  
Organization Procurement and  
Materials Management

HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

TITLE:

Approved by

NONRADIOACTIVE HAZARDOUS MATERIALS/  
HAZARDOUS WASTE (HM/HW) SHIPMENTS

  
D. K. Quigley, Manager,  
Procurement and Materials Mgmt

## 1.0 INTRODUCTION

The Department of Transportation regulates the interstate transportation of hazardous materials under the Hazardous Materials Transportation Act (HMTA) and implemented in 49 CFR 100 - 199. Washington is an agreement state and requires full compliance with DOT for intrastate transportation. The regulations address all modes of transportation (air, rail, highway, waterway, and pipeline), and establish requirements for shipping papers, proper containers, marking and labeling of containers, placarding of vehicles, and incident reporting. These regulations apply to any material that may pose undue hazard in transportation including all hazardous materials and hazardous wastes.

In the State of Washington, the Washington Department of Ecology (WDOE) regulates hazardous wastes through Chapter 173-303 WAC "Dangerous Waste Regulations" as approved by the US Environmental Protection Agency (EPA). The WDOE further classifies hazardous wastes into dangerous waste (DW) and extremely hazardous waste (EHW) and defines conditions for their evaluation, handling, control and disposal. The WHC manuals WHC-CM-5-16, Nonradioactive Dangerous Waste Packaging and Disposal Requirements, WHC-EP-0063, Hanford Radioactive Solid Waste Packaging, Storage and Disposal Requirements and WHC-CM-7-05 Environmental Compliance give additional information on hazardous wastes. In any event, the packaging, shipping and handling of either hazardous materials or hazardous wastes in Washington are regulated, as applicable, by USDOT, EPA or WDOE, whichever is the most stringent.

### 1.1 OFFSITE HM/HW SHIPMENTS

For offsite HM/HW shipments, Traffic at the 1100 Area reviews and approves the Hazardous Material Shipment Record (HMSR) or Uniform Hazardous Waste Manifest (UHW) from the shipper and completes the final shipping papers or bills of lading for transportation offsite. Traffic personnel rely on the shipper to supply complete, accurate and certified information by means of the HMSR or UHW so that they can complete the shipping papers. To facilitate this flow of information to Traffic, the shipper must be familiar with the Code of Federal Regulations, Title 49, Parts 171-179. All offsite shipments must be in full compliance with both Federal and State Regulations as applicable.

NOTE: Offsite or onsite radioactive material shipments require either an Offsite Radioactive Shipment Record (ORSR), Onsite Radioactive Shipment Record (RSR) or an Onsite Routine Radioactive Shipment Record (ORRSR) as appropriate. Their uses will be discussed in later sections.

## 1.2 ONSITE HM/HW SHIPMENTS

For onsite shipments of HM/HW the same general procedures apply. The HMSR filled out by the shipper generally serves as the only documentation to accompany the shipment onsite. Onsite shipments of hazardous wastes require the Uniform Hazardous Waste Manifest (UHWI). DOE-RL Order 5480.1, Chapter III, requires that all onsite shipments of HM/HW comply with the DOT regulations, or at least be conducted with an equivalent degree of safety. Deviations from DOT regulations requires DOE-RL approval.

## 2.0 PROCEDURE FOR MAKING NONRADIOACTIVE HM/HW SHIPMENTS

This section describes in general terms the actions required to prepare hazardous (nonradioactive) material/waste for transport. A schematic illustration of this process is given in Figure III-2-1.

1. Define the material to be shipped by chemical, technical or generic name. Determine or define hazardous properties. Determine quantity of material to be shipped (by weight, volume, or otherwise, as appropriate).
2. If material to be shipped is currently packaged, determine if packaging meets DOT requirements and is in good condition.
3. If material is a waste, determine if it is a hazardous waste per 40 CFR 261 or Washington State Department of Ecology "Dangerous Waste Regulations," WAC 173-303. The Site Hazardous Waste Engineering Support Unit (SHWESU) of Defense Waste Management Division can provide assistance in this area.
4. Consult the Hazardous Materials Table (HMT) in 49 CFR 172.101 and its Appendix and Exhibit III-2-1 for the HMT format.
  - a. Determine if material is a reportable quantity of a hazardous substance (49 CFR 172.101, Appendix)
  - b. Determine if material is a Poison Inhalation Hazard (173.3a)
  - c. Establish proper shipping name (Column 2 of HMT).
  - d. Determine hazard class (Column 3 of HMT).
  - e. Determine identification number (Column 3(a) of HMT).
  - f. Determine labeling requirements (Column 4 of HMT).
  - g. Determine if any packaging exceptions apply to the shipment (Column 5(a) of HMT).

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- h. Determine specific packaging requirements for the shipment (Column 5(b) of HMT).
  - i. See quantity and storage restrictions found in Columns 6 and 7 of HMT if shipment is by aircraft, passenger carrying railcar or vessel.
5. If material is a hazardous waste, submit a chemical waste disposal request to the SHWESU in accordance with WHC-CM-5-16.
6. Title 49 CFR Part 173 contains specific requirements for packaging hazardous materials or wastes identified in the HMT. Examine these requirements closely since they specify specific types of packaging, loading requirements and restrictions, internal packaging, and markings specific to the commodity being shipped.
7. Select a container based on the following considerations:
  - a. The applicable determinations of items 1 through 6 above
  - b. Size, shape, weight, and volume of material to be shipped
  - c. Destination, mode of transport, and consignee's ability to handle receipt of the shipment
  - d. Availability of shipping containers.
8. If material is still in the original packaging or the waste was previously packaged, verify regulatory compliance to today's current regulations through inspection of the DOT specification markings and labeling on the container for both hazardous material and waste and review of the documentation describing the packaging of the waste. If the packaged material is not in compliance, it will have to be repackaged or overpacked in a Salvage Drum (See 49 CFR 173.3 (c)).
9. If material is unpackaged or requires repackaging, obtain an acceptable container and inspect it. A quality assurance/quality control inspection may be required.
10. Load the container with authorized contents only, and assemble and seal the package in accordance with appropriate procedures. Packages must be marked and labeled in accordance with the regulations found in 49 CFR 172, Subpart D and E, respectively.
11. If shipment is to be made from a regulated (radiation control) area, a radiation survey is required to determine radiation and contamination information and to assure the exterior surfaces are free of contamination.

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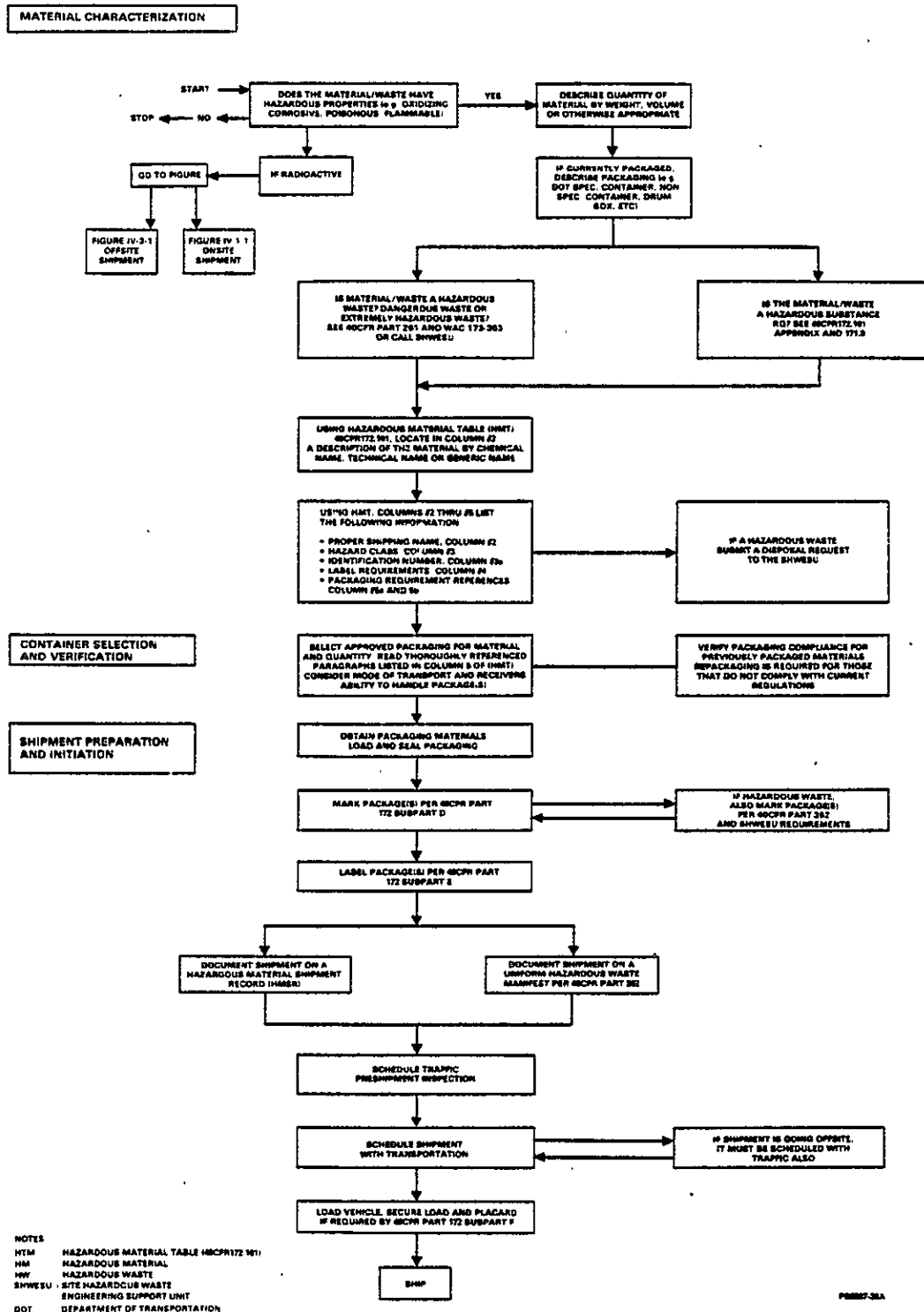


Figure III-2-1. HM/HW Shippers Guide.

9 0 1 1 7 7 0 5 1 5

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(1) +/ N/ W	(2) Hazardous materials descriptions and proper shipping names	(3) Hazard class	(3A) Identi- fication number	(4) Label(s) required (if not excepted)	(5) Packaging		(6) Maximum net quantity in one package		(7) Water shipments		
					(a) Excep- tions	(b) Specific require- ments	(a) Passenger- carrying aircraft or railcar	(b) Cargo only aircraft	(a) Cargo vessel	(b) Pas- senger vessel	(c) Other requirements
	Adhesive	Combustible liquid	UN1133	None	173.118a	None	No limit	No limit	1,2	1,2	Keep dry. Slow away from
	Adhesive	Flammable liquid	UN1133	Flammable liquid	173.118	173.132	1 quart	10 pounds			
	Cement	Combustible liquid	NA1133	None	173.118a	None	No limit				
	Cement	Flammable liquid	NA1133	Flammable liquid	173.118	173.132	1 quart				
	Chlorobenzol. See Chlorobenzene p-Chlorobenzoyl peroxide	Organic peroxide	UN2113	Organic peroxide	None	173.157 173.158	Forbidden	25 pounds	1	1	
	Chromium oxychloride or Chromyl chloride	Corrosive material	UN1758	Corrosive	None	173.247	Forbidden	1 gallon	1	1	Keep dry. Glass carboys not permitted on passenger vessels.
	Cigar and cigarette lighter fluid. See Lighter fluid										
	Cigarette lighter (or other similar ignition device)	Flammable gas	UN1057	Flammable gas	173.21 175.10	173.308	21 ounces	25 pounds	1	1	
	Cigarette lighter (or other similar ignition device)	Flammable Liquid	UN1226	Flammable liquid	173.21 175.10	173.118	Forbidden	Forbidden	1	1	
	Cigarette load	Class C explosive		Explosive C	None	173.111	50 pounds	150 pounds	1,2	1,2	
	Cyanide or cyanide mixture, dry	Poison B	UN1588	Poison	173.364	173.370	25 pounds	200 pounds	1,2	1,2	Keep dry. Slow away from acids.
	Driers, paint or varnish, liquid, n.o.s.	Combustible liquid	UN1168	None	173.118a	None	No limit	No limit	1,2	1,2	
	Driers, paint or varnish, liquid, n.o.s.	Flammable liquid	UN1168	Flammable liquid	173.118 173.128	173.128	1 quart	55 gallons	1,2	1	
	Paint	Combustible liquid	UN1263	None	173.118a	None	No limit	No limit	1,2	1,2	
	Paint	Flammable liquid	UN1263	Flammable liquid	173.118 173.128	173.128	1 quart	55 gallons	1,2	1	
	Paint or paint related material	Corrosive material	NA1760	Corrosive	173.244	173.245	1 quart	1 gallon	1,2	1,2	
	Paint related material	Combustible liquid	NA1263	None	173.118a	None	No limit	No limit	1,2	1,2	
	Paint related material	Flammable liquid	NA1263	Flammable liquid	173.118 173.128	173.128	1 quart	55 gallons	1,2	1	

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Exhibit III-2-1. Hazardous Material Table Format.

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12. For offsite shipments, schedule shipment in advance with Traffic and Transportation, where appropriate.
13. A hazardous material shipment (not hazardous waste) needs a completed Hazardous Material Shipping Record (HMSR) form per instructions found in Section 3.0 that follows. The shipper retains the pink copy and sends the completed HMSR together with other pertinent papers or instructions with the shipment.
14. If the material is a hazardous waste, complete a Uniform Hazardous Waste Manifest (UHWM) per instruction found in Section 4.0 that follows. Send completed manifest together with other pertinent papers or instructions with the shipment.
15. Furnish appropriate placards (see 49 CFR part 172, Subpart F) to the carrier, or if vehicle is equipped with permanent placards, assure that placards are turned to the proper hazards.
16. Assure that riggers or truck drivers are aware of any tiedown requirements to secure load. It is the packager/shipper's responsibility to inspect and approve securing of all loads to assure tiedown requirements are met. Guidelines for tiedowns are found in 49 CFR 177.834(a).
17. Assure, prior to loading, the transporting vehicle has no obvious defects and that its Class A/B preventative maintenance inspections are current.

**3.0 PREPARING A HAZARDOUS MATERIAL SHIPMENT RECORD**

The following instructions are keyed to numbered blocks on the HMSR specimen copy shown in Exhibit III-3-1.

**3.1 SHIPMENT DESCRIPTION SECTION COMPLETED BY ORIGINATOR**

1. Provide the complete address of the consignee, and designate an individual to whom the shipment is being sent.
2. Identify originating facility. Originator signs and dates form, checking box indicating originating contractor.
3. Check appropriate boxes to indicate mode of transport and method of payment for offsite shipment. Provide complete cost code.
4. Describe material to be shipped and its packaging as required by column headings. It is essential that all data be provided for each hazardous material being shipped.



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SHIPPING INST.		HAZARDOUS MATERIAL SHIPMENT RECORD (HMSR)			
SHIP TO: Company _____ Address _____ City, State, Zip _____ Attention: _____		Originating Facility Building _____ Area _____		Originator Signature _____ Date _____	
		FROM: <input type="checkbox"/> WHC <input type="checkbox"/> KEH <input type="checkbox"/> PNL <input type="checkbox"/> OTHER _____			
		OFFSITE ONLY: SHIP: <input type="checkbox"/> PREPAID <input type="checkbox"/> COLLECT			
		VIA: <input type="checkbox"/> Parcel Post <input type="checkbox"/> Air Parcel Post <input type="checkbox"/> Freight (Rail/Truck)			
		<input type="checkbox"/> Air (Passenger) <input type="checkbox"/> Air (Cargo) Cost Code: _____			
<b>CONTAINERS/PACKAGING</b>					
Number of Containers	Type	DOT Spec	Package Dimensions	Quantity Pkg	Gross Wt Each Pkg
<b>3.1 Shipment Description Section</b>					
See 49 CFR 172.101(c) Hazardous Material Table					
Proper Ship Name: _____					
Hazard Class: _____					
UN/NA No.: _____					
List Secondary Hazards: _____					
List Labels Req'd/Applied _____					
Proper Ship Name: _____					
Hazard Class: _____					
UN/NA No.: _____					
List Secondary Hazards: _____					
List Labels Req'd/Applied _____					
Proper Ship Name: _____					
Hazard Class: _____					
UN/NA No.: _____					
List Secondary Hazards: _____					
List Labels Req'd/Applied _____					
Total No. Containers		Gross Wt of Shipment		Identify Placards Required:	
5				1. _____ 3. _____ 2. _____ 4. _____	
Identify Property Control or Return Order No.:		6			
Material in manufacturers original container: <input type="checkbox"/> Yes <input type="checkbox"/> No		Describe Internal Packaging: _____			
Container free of deterioration or damage: <input type="checkbox"/> Yes <input type="checkbox"/> No		7			
Container acceptability documented: <input type="checkbox"/> Yes <input type="checkbox"/> No					
Material is packaged, sealed, marked and labeled to meet DOT requirements <input type="checkbox"/> Yes <input type="checkbox"/> No					
RADIATION RELEASE		Survey No. _____		Date _____	
		8		RM Signature _____	
				Print Name _____	
<b>3.2 CERTIFICATION SECTION</b>					
CONTRACTORS CERTIFICATION		This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation:		This shipment is within the Limitations prescribed for: <input type="checkbox"/> Passenger Aircraft <input type="checkbox"/> Cargo Aircraft <input type="checkbox"/> NA Aircraft	
Authorizing Signature: _____		1		Print Name _____	
				2	
				Date: _____	
<b>3.3 FOR OFFSITE SHIPMENTS - ADDITIONAL APPROVAL REQUIRED</b>					
WHC		B.L. No. _____		Date Shipped _____	
		ETA _____		Routing _____	
				Special Considerations _____	
TRAFFIC		WHC Traffic: _____		1	
				WHC Shipping: _____	

54-30001-596 (11-87)  
U.S. GOVERNMENT PRINTING OFFICE: 1987 - 581-711EXHIBIT III-3-1. Specimen Copy of a  
Hazardous Material Shipment Record (HMSR).

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5. Indicate total number of shipping units and gross weight of shipment. Also identify placards required on the vehicle. See 49 CFR 172 Subpart F.
6. Identify property control, release to ship or return order numbers, as applicable.
7. Answer questions here. Describe internal packaging if any, include type and size of inner containers and quantity of material contained in each.
8. Have the Radiation Protection Technologist (RPT) complete the radiation release. Space is available for the survey number, date, and signature of the RPT who is responsible for the survey.

3.2 CERTIFICATION SECTION COMPLETED BY CERTIFIER

1. The authorizing signature shall be that of a delegated employee who has successfully completed the "Certification of Hazardous Material Shipments" course. Retraining in this course is required every two years to retain signature authorization.
2. For offsite shipments made via aircraft, the appropriate boxes must be checked to indicate prescribed limitations are met.

3.3 OFFSITE SHIPMENT APPROVAL SECTION COMPLETED BY TRAFFIC

1. Traffic assigns a bill of lading number, identifies the date shipped and routing, and approves release of shipment to the carrier.

4.0 PREPARING A UNIFORM HAZARDOUS WASTE MANIFEST (UHWM)

The following instructions are keyed to numbered blocks on a specimen copy of the UHWM form used (Exhibit III-4-1). For additional guidance in preparing this form, contact the Site Hazardous Waste Engineering Support Unit (SHWESU), WHC-CM-5-16 or Traffic.

Approved continuation sheets are available from the SHWESU, if necessary.

Items A through K on the form are not required by Federal regulations. However, states may require generators to complete some or all of the items as part of the state manifest reporting requirements. The SHWESU will notify the generator on a case-by-case basis if any of this data is required, for example Box I requires WDOE Waste Codes (e.g, D001, WPO1, etc).

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HAZARDOUS MATERIAL PACKAGING  
AND SHIPPINGNONRADIOACTIVE HAZARDOUS MATERIALS/  
HAZARDOUS WASTE (HM/HW) SHIPMENTSManual  
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Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved OMB No. 2050-0039, Expires 9-30-88

UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1 of	Information in the shaded areas is not required by Federal law.	
3. Generator's Name and Mailing Address				A. State Manifest Document Number		
4. Generator's Phone ( )				B. State Generator's ID		
5. Transporter 1 Company Name		6. US EPA ID Number	C. State Transporter's ID			
7. Transporter 2 Company Name		8. US EPA ID Number	D. Transporter's Phone			
9. Designated Facility Name and Site Address		10. US EPA ID Number	E. State Transporter's ID			
			F. Transporter's Phone			
			G. State Facility's ID			
			H. Facility's Phone			
11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)			12. Containers	13. Total Quantity	14. Unit Wt/Vol	15. Waste No.
			No.	Type		
a.						
b.						
c.						
d.						
J. Additional Descriptions for Materials Listed Above				K. Handling Codes for Wastes Listed Above		
15. Special Handling Instructions and Additional Information						
16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations. If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.						
Printed/Typed Name			Signature		Month Day Year	
17. Transporter 1 Acknowledgement of Receipt of Materials						
Printed/Typed Name			Signature		Month Day Year	
18. Transporter 2 Acknowledgement of Receipt of Materials						
Printed/Typed Name			Signature		Month Day Year	
19. Discrepancy Indication Space						
20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.						
Printed/Typed Name			Signature		Month Day Year	

Style F15REV-6 Labelmaster, Div. of American Labelmark Co., Inc. 60646

EPA Form 8700-22 (Rev. 9/86) Previous editions are obsolete.

EXHIBIT III-4-1. Specimen Copy of Uniform Hazardous Waste Manifest.

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4.1 GENERATOR SECTION COMPLETED BY ORIGINATOR

1. Enter the generator's U.S. Environmental Protection Agency (EPA) identification number. At the Hanford Site, the identification number is WA 789 000 8967. Also enter a manifest document number assigned by the Site Hazardous Waste Management Engineering Support Unit.
2. Enter total number of pages used to complete the manifest (main page plus each approved continuation sheet).
3. Enter the name and address of the generator.
4. Enter the phone number of the generator.
5. Identify the first transporter company by name.
6. Enter transporter EPA identification number, WA 789 000 8967 if WHC Transportation is used.
7. Enter second transporter company name, if applicable.
8. Enter second transporter EPA identification number, if applicable.
9. Identify the company and site address of the facility designated to receive the waste. The address must be the site delivery location not the company mailing address.
10. Enter the EPA number for the designated receiving facility.
11. Enter the DOT description, which includes the proper shipping name, hazard class, and identification number (United Nations (UN) or North American (NA) as applicable) for each waste as identified in 49 CFR 172. If a hazardous substance, place a reportable quantity (RQ) in the HM box and also identify the constituents making the material a hazardous substance. Any not otherwise specified (N.O.S.) entry must identify the constituent that makes it hazardous. If dangerous when wet, place words "Dangerous When Wet" in box in association with proper shipping name. If toxic by inhalation place words "Poison-Inhalation Hazard" in box in association with the basic description.
12. Enter the number and type of containers for each waste using appropriate abbreviations from the listing below.

TYPE OF CONTAINERS

DM = Metal drums, barrels, kegs  
DW = Wooden drums, barrels, kegs  
DF = Fiberboard or plastic drums, barrels, kegs  
TP = Tanks, portable

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TT = Cargo tanks (tank trucks)  
TC = Tank cars  
DT = Dump trucks  
CY = Cylinders  
DM = Metal boxes, cartons, cases  
CF = Fiber or plastic boxes, cartons, cases  
BA = Burlap, cloth, paper or plastic bags

13. Enter the total quantity of waste described on each line.
14. Enter the appropriate abbreviation from the listing below to indicate the unit of measure. The preferred unit of measure is K for kilograms.

**UNIT OF MEASURE**

G = Gallons (liquid only)	L = Liters (liquids only)
P = Pounds	K = Kilograms
T = Tons (2,000 lb)	M = Metric tons (1,000 kg)
Y = Cubic yard	N = Cubic meters

15. Generators may use this space to indicate special transportation, treatment, storage, or disposal information, etc.
16. The generator must read, sign (by hand), and date the certification statement. The authorizing signature shall be that of a delegated individual who has successfully completed the "Certification of Hazardous Material Shipments" course or "Hazardous Waste Shipment Certification" course.

**4.2 TRANSPORTERS SECTION COMPLETED BY TRANSPORTER**

1. Enter (print or type) the name of the person accepting the waste described on the manifest by signing and entering date of receipt.
2. Same as item 1 but for the second transporter, if applicable.

**4.3 FACILITY SECTION COMPLETED BY TREATMENT, STORAGE, DISPOSAL FACILITY**

1. Receiving facility must note any significant discrepancies between the wastes described on the manifest and the waste actually received at the facility.
2. The name of the person accepting the waste on behalf of the receiving facility must be entered (printed or typed). The person must acknowledge acceptance of waste described on the manifest by signing and entering the date of receipt.

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5.0 EXAMPLES OF HAZARDOUS MATERIALS SHIPMENTS

Examples illustrating the steps used in preparing specific HM shipments are shown in Appendix B.

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Organization Procurement and  
Materials Management

Approved by

**D. K. Quigley, Manager,  
Procurement and Materials Mgmt.**

1. Assure that radioactive materials are loaded into packages that have been inspected, maintained, and approved for onsite transport. An auditable record of the inspection, maintenance, and certification that the package is ready for use must be maintained at the packager's facility. This includes a copy of the current SARP or COC or the Type A Certification document MLM 3245, wherever applicable.

2. Obtain agreement with the consignee for delivery of the material to the consignee's facility. This agreement may include prescheduling of the shipment and additional notification of an estimated time of arrival (ETA) just prior to shipment departure.
3. Arrange for the use of a vehicle and tiedown equipment approved for transporting the package to its destination, and assure prior to loading, that vehicles (tractor and/or trailer) are tagged showing the preventative maintenance and class A/B inspections are current.
4. Verify that all SARP requirements governing the use of each container are incorporated into applicable operating procedures and followed.
5. Schedule personnel to convoy the shipment when required by the SARP or by the safeguards and security requirements of MRP 5.27, "Movement of Radioactive Material."
6. Resolve all questions concerning the special services required while the package is being transported to the consignee's facility (e.g., cooling water in case of delay enroute, control of personnel because of a radiation dose; escort by Patrol for traffic control, etc.).
7. Properly complete an Onsite Radioactive Shipment Record (RSR, Exhibit IV-1-1) form for each shipment. This form must accompany the shipment to its destination. Certain routine onsite shipments may be shipped using an Onsite Routine Radioactive Shipment Record (ORRSR). See Section 2.4 for applicability.
8. Supervise and approve the loading and tie down of the package(s) into or onto the transport vehicle to assure compliance with applicable loading and tiedown requirements as specified in the procedure, SARP, COC, etc.
9. Assure that the transport vehicle is placarded radioactive, when required, and as appropriate for other hazardous materials being transported.
10. Make the following notifications when necessary:
- a. Notify the Fire Battalion Chief on duty of the starting time, estimated duration of the shipment, route to be followed, and destination, to expedite assistance, if needed.
  - b. Notify the Bus and Rail Supervisor of the departure time, route, destination, and ETA to assist in traffic control.

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- c. Notify Patrol of the departure time, route, destination, and ETA. Request escort service, as required.

NOTE: Depending on the quantities shipped, some SNM shipments shall require classified notifications.

11. Provide the completed RSR to the truck driver, train engineer or convoy leader, as appropriate. Require that receiver's signature be obtained on the RSR indicating acceptance of the shipment.
12. Assure that an RPT has surveyed the package(s) and the vehicle. If a radiation protection convoy is required, an RPT will be assigned to the convoy team and provide the instrumentation needed to monitor the radiation dose and contamination level. The RPT will accompany the shipment to the onsite destination and will be prepared to take emergency action to minimize exposure to personnel and to the environs in the event of an accident.
13. Placard the vehicle in accordance with DOT requirements. Over placarding is acceptable for onsite shipments.
14. Maintain a copy of the RSR for three months as a record of the shipment.

### 1.1.3 Vehicle Driver

The driver of the transporting vehicle shall be appropriately trained by his management for transporting hazardous materials and shall:

1. Assure that the vehicle is appropriate for the load and free of defects that could affect the safe transport of the material.
2. Assure preventative maintenance and Class A/B inspections are current.
3. Assure that the shipment is properly positioned and secured to the vehicle.
4. Assure that the vehicle is placarded for the cargo.
5. Assure that the radiation level in the cab has been determined to be within acceptable limits.
6. Assure that radio equipment in the cab, if required, is functioning properly.

## 1.2 NORMAL ONSITE RADIOACTIVE MATERIALS SHIPMENTS, PROCEDURES

Onsite radioactive materials shipments require an RSR be completed for each shipment except as provided in this Part, Section 1.4, dealing with routine shipments covered with an Onsite Routine RSR.

This section describes generally the actions required to prepare radioactive material for transport onsite. A schematic flow diagram of this process is given in Figure IV-1-1.

NOTE: If the material to be shipped is radioactive waste or radioactive mixed waste scheduled for storage or disposal in the 200 Area burial grounds, additional characterization and packaging requirements must be met. These requirements are found in WHC-EP-00063, "Hanford Radioactive Solid Waste Packaging, Storage and Disposal Requirements."

NOTE: In addition to this general procedure, specific operating procedures, prepared and controlled by the facility operations, shall be followed when packaging and transporting radioactive material shipments onsite. These procedures shall be reviewed and approved by Packaging Development for uniformity, SARP requirements and administrative controls.

### 1.2.1 Definition of Material

Define the material to be shipped in the following manner. (For additional assistance, see Appendix C, "Radioactive Material Characterization Tables").

1. List the radionuclides that are present (e.g.,  $^{239}\text{Pu}$ ,  $^{233}\text{U}$ , and  $^{137}\text{Cs}$ ).
2. Determine the level of radioactivity present in terms of curies. If fissile radioactive material (49 CFR 173.403(j)), determine the grams fissile for criticality control if applicable. Determine if material qualifies as a Hazardous Substance Reportable Quantity (RQ). See 171.8 and 172.101 Appendix.
3. Determine if material will be shipped as "normal form" or "special form" [49 CFR 173.403(s) and (z)].
4. If normal form, determine the physical form (e.g., solid, liquid, or gas) and the chemical form (e.g., nitrate, oxide, elemental, etc.) of the radioactive material.
5. Determine if other hazardous materials are present or if other hazardous characteristics are exhibited (e.g., corrosive, flammable liquid, oxidizing material, etc.).
6. Identify appropriate  $A_1$  or  $A_2$  values for radionuclides contained.
  - o Determine  $A_1$  values for radionuclides in special form (49 CFR 173.433, 173.435).
  - o Determine  $A_2$  values for radionuclides in normal form (49 CFR 173.433, 173.435).

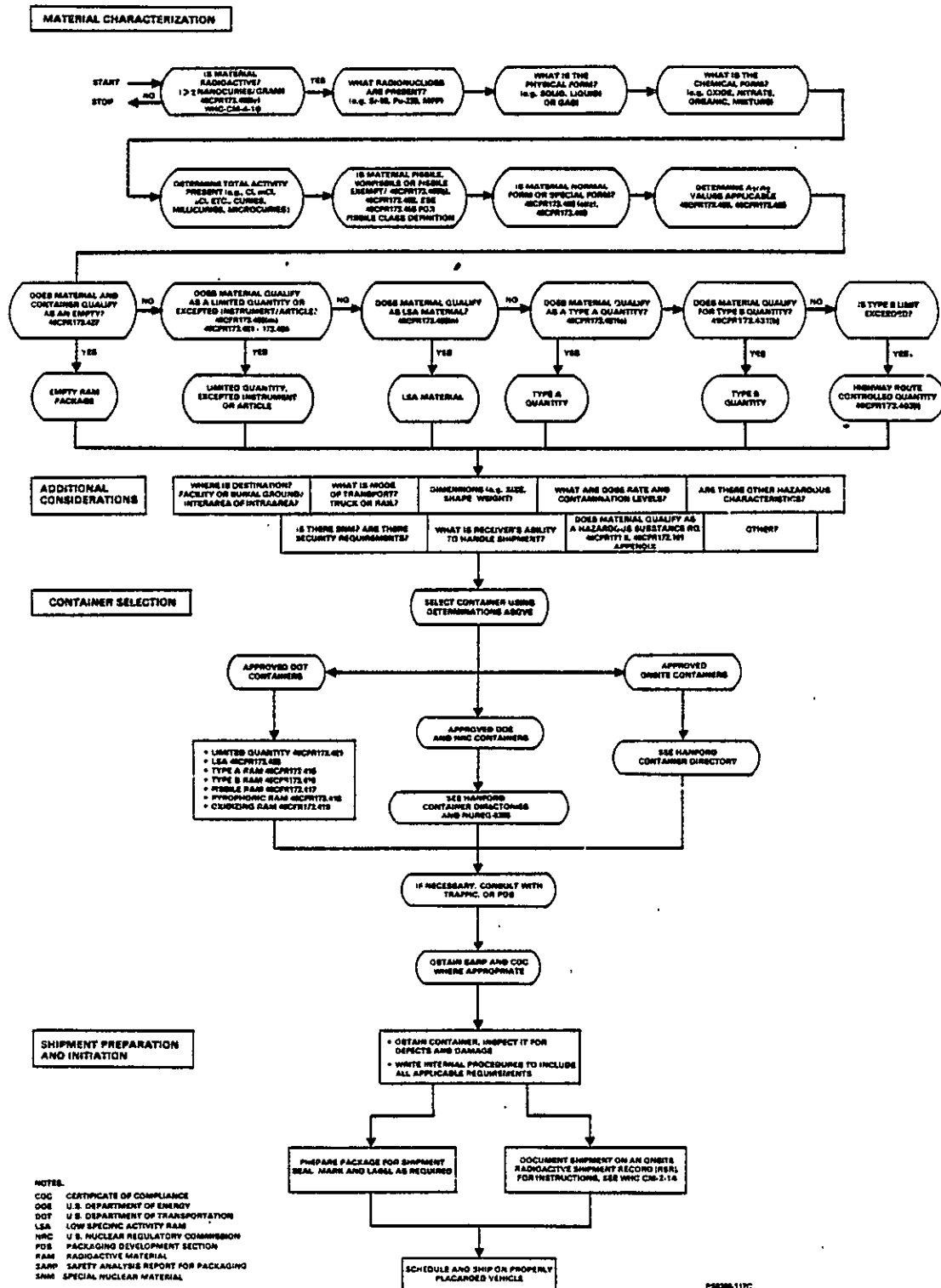


Figure IV-1-1. Onsite Radioactive Material Shippers Guide

## RADIOACTIVE MATERIAL SHIPMENTS

NOTE: Tables IV-1-1 and IV-1-2 list  $A_1$  and  $A_2$  values for commonly shipped radionuclides in special form and normal form, respectively.

7. Determine quantity category based on the radionuclides contained, their  $A_1$  or  $A_2$  values as appropriate and the number of curies to be packaged in each container (e.g., cask, box, drum). See the following sections of CFR for the quantities listed:
  - o Low Specific Activity Radioactive (LSA) Material, 49 CFR 173.403(n)
  - o Limited Quantity, 49 CFR 173.403(m) and 49 CFR 173.421-.424
  - o Type A Quantity, 49 CFR 173.431(a)
  - o Type B Quantity, 49 CFR 173.431(b)
  - o Highway Route Controlled Quantity (HRCQ), 49 CFR 173.403.(l).

NOTE: Tables IV-1-1 and IV-1-2 list limiting values for each quantity category in terms of curies for commonly shipped radionuclides in special form and normal form respectively.

#### 1.2.2 Shipping Container Selection, Preparation and Transport

1. Select a shipping container based on the following considerations:
  - a. The quantity, type, form and classification of radionuclides to be packaged.
  - b. Need for shielding and/or cooling
  - c. Size, shape, and weight of material to be shipped
  - d. Destination, mode of transport, and consignee's ability to handle receipt of the shipment
  - e. Dose rate and contamination considerations
  - f. Availability of shipping containers
  - g. Regulations found in DOE-RL Order 5480.1, Change 1, Chapter III, 49 CFR 173.400-173.478
  - h. If waste, the additional requirements of WHC-EP-0063.

Westinghouse Hanford onsite shipments, where possible, shall be made in DOT-specification containers loaded to meet DOT regulations as found in 49 CFR 173.401-173.478 or in containers with a valid COC (Shipper must be able to document the contents meet the authorized contents requirement applicable

Quantity Category  Radionuclides	Limited Quantity <sup>2,3</sup>	Type A Quantity <sup>2,4</sup>	Type B Quantity <sup>5</sup>	HRCQ <sup>6</sup>	Low Specific Activity Material LSA <sup>7</sup>
	$\leq 10^{-3} A_1$	$\leq A_1$	$> A_1$	$\geq 3,000 \times A_1$	Activity program of matrix
<sup>241</sup> Am	0.008	8	$> 8$	24,000	N/A
<sup>243</sup> Am	0.008	8	$> 8$	24,000	N/A
<sup>14</sup> C	1	1,000	$> 1,000$	30,000	N/A
<sup>60</sup> Co	0.007	7	$> 7$	21,000	N/A
<sup>137</sup> Cs	0.03	30	$> 30$	30,000	N/A
<sup>238</sup> Pu	0.003	3	$> 3$	9,000	N/A
<sup>239</sup> Pu	0.002	2	$> 2$	6,000	N/A
<sup>240</sup> Pu	0.002	2	$> 2$	6,000	N/A
<sup>241</sup> Pu	1	1,000	$> 1,000$	30,000	N/A
<sup>242</sup> Pu	0.003	3	$> 3$	9,000	N/A
<sup>89</sup> Sr	0.1	100	$> 100$	30,000	N/A
<sup>90</sup> Sr	0.01	10	$> 10$	30,000	N/A
M.F.P.	0.01	10	$> 10$	30,000	N/A
<sup>233</sup> U	0.1	100	$> 100$	30,000	N/A
<sup>235</sup> U	0.1	100	$> 100$	30,000	N/A
<sup>238</sup> U	Unlimited	Unlimited	Unlimited	30,000	N/A
U <sub>(NAT)</sub>	Unlimited	Unlimited	Unlimited	30,000	N/A
U <sub>(ENR &lt; 20%)</sub>	Unlimited	Unlimited	Unlimited	30,000	N/A
U <sub>(ENR &gt; 20%)</sub>	0.1	100	$> 100$	30,000	N/A
U <sub>(depleted)</sub>	Unlimited	Unlimited	Unlimited	30,000	N/A

NOTE: All values listed are in curies (Ci) unless otherwise stated.

<sup>1</sup>For mixtures of radionuclides, the most restrictive values for any one member of the mixture, establishes the mixture limiting values. [Exceptions, see 49CFR 173.433(b)].

<sup>2</sup>All values indicated, limit the activity within a given package.

<sup>3</sup>For excepted instruments and articles see 49CFR 173.422, 173.423, 173.424.

<sup>4</sup>Maximum activity values, if exceeded are Type B Quantity.

<sup>5</sup>Package contents, restricted by Package Approval Documents only (e.g., SARP, COC).

<sup>6</sup>Highway Route Controlled Quantity (HRCQ) (Minimum values listed).

<sup>7</sup>Not applicable to special form material.

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Table IV-1-1. Activity Limits for Commonly Shipped Radionuclides in Special Form.

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Quantity Category  Radionuclides	Limited Quantity <sup>2,3,4</sup>	Type A Quantity <sup>2,5</sup>	Type B Quantity <sup>4</sup>	HRCQ <sup>6,7</sup>	Low Specific Activity Material LSA <sup>8</sup>
	$\leq 10^{-3} A_2$	$\leq A_2$	$> A_2$	$\geq 3,000 \times A_2$	Activity per gram of matrix
<sup>241</sup> Am	0.008 mCi	0.008	$> 0.008$	24	0.0001 mCi/g
<sup>243</sup> Am	0.008 mCi	0.008	$> 0.008$	24	0.0001 mCi/g
<sup>14</sup> C	0.06	60	$> 60$	30,000	0.3 mCi/g
<sup>60</sup> Co	0.007	7	$> 7$	21,000	0.3 mCi/g
<sup>137</sup> Cs	0.01	10	$> 10$	30,000	0.3 mCi/g
<sup>238</sup> Pu	0.003 mCi	0.003	$> 0.003$	9	0.0001 mCi/g
<sup>239</sup> Pu	0.002 mCi	0.002	$> 0.002$	6	0.0001 mCi/g
<sup>240</sup> Pu	0.002 mCi	0.002	$> 0.002$	6	0.0001 mCi/g
<sup>241</sup> Pu	0.1 mCi	0.1	$> 0.1$	300	0.005 mCi/g
<sup>242</sup> Pu	0.003 mCi	0.003	$> 0.003$	9	0.0001 mCi/g
<sup>89</sup> Sr	0.01	10	$> 10$	30,000	0.3 mCi/g
<sup>90</sup> Sr	0.4 mCi	0.4	$> 0.4$	1,200	0.005 mCi/g
M.F.P.	0.4 mCi	0.4	$> 0.4$	1,200	0.005 mCi/g
<sup>233</sup> U	0.1 mCi	0.1	$> 0.1$	300	0.005 mCi/g
<sup>235</sup> U	0.2 mCi	0.2	$> 0.2$	600	0.005 mCi/g
<sup>238</sup> U	Unlimited	Unlimited	Unlimited	30,000	Unlimited
U <sub>(NAT)</sub>	Unlimited	Unlimited	Unlimited	30,000	Unlimited
U <sub>(ENR &lt;20%)</sub>	Unlimited	Unlimited	Unlimited	30,000	Unlimited
U <sub>(ENR &gt;20%)</sub>	0.1 mCi	0.1	$> 0.1$	300	0.005 mCi/g
U <sub>(depleted)</sub>	Unlimited	Unlimited	Unlimited	30,000	Unlimited

NOTE: All values listed are in curies (Ci) unless otherwise stated.

<sup>1</sup>For mixtures of radionuclides, the most restrictive values for any one member of the mixture, establishes the mixture limiting values. [Exceptions, see 49CFR 173.433(b)].

<sup>2</sup>All values indicated, limit the activity within a given package.

<sup>3</sup>Values shown for solids and gases. For liquids divide value shown by 10.

<sup>4</sup>For excepted instruments and articles see 49CFR 173.422, 173.423, 173.424.

<sup>5</sup>Maximum activity values, if exceeded are Type B Quantity.

<sup>6</sup>Package contents, restricted by Package Approval documents only (e.g., SARP, COC).

<sup>7</sup>Highway Route Controlled Quantity (HRCQ) (Minimum values listed).

<sup>8</sup>See 49CFR 173.403(n) for additional specific criteria.

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Table IV-1-2. Activity Limits for Commonly Shipped Radionuclides in Normal Form.

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in 49 CFR and COC) issued by the NRC or DOE. Where this requirement cannot be met, other containers may be used as long as an equivalent degree of safety is provided either by design or the use of administrative controls. Such containers must be used under the strict adherence to requirements of a SARP reviewed by the Packaging and Shipping Sub-Council and approved by the WHC approval authority. Additional approval is needed from DOE-RL for onsite shipments of HRCQ or fissile material. All packaging and shipping procedures used must reflect the requirements of the SARP prior to the use of the container. Loading requirements for the specification container DOT 6M are given in 49 CFR 173.417(b)(2). DOT 7A containers are authorized by 49 CFR 173.415, but their use must be supported by a safety assessment. Some 7A containers are qualified in MLM 3245. The shipper must maintain a file containing the SARP and other pertinent documentation (e.g., drawings, inspection records, etc.) pertaining to the use of the container for at least 1 year after last usage.

The "Hanford Shipping Container Directory" is a catalog of commonly used containers used by facilities for shipping radioactive materials onsite. It is not a shipping document. Additional guidance on container selection may be obtained from Packaging Development.

2. Obtain the container and inspect it. Work procedures, COCs, and SARPs list inspection requirements, as appropriate, and may require quality assurance/quality control verification.
3. Load the container with authorized contents only. Assemble and seal the package in accordance with appropriate procedures.
4. Arrange for a radiation survey of the package(s) to determine that smearable contamination limits and radiation dose rate limits are not exceeded (49 CFR 173.443 and 173.441, respectively). Certain packaging systems are exempt from these limits and are instead controlled by limits specified in approved SARPs.
5. Mark and label each package in compliance with its SARP, 49 CFR, or DOE-RL Order 5480.1A, Change 1, Chapter III, where applicable. To the extent practical, provide the following information on each package:
  - a. Responsible operating component (e.g., 225-B, WESF)
  - b. Date sealed or shipped
  - c. Radiation survey data
  - d. Estimated activity and identity of radioactive materials present (e.g., 2 Ci, Mixed Fission products (MFP))
  - e. Gross weight if >55 lb

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- f. Radioactive labels (use either DOT approved labels or SARP approved alternative).
- g. Other hazard class labels, as appropriate (e.g., corrosive, flammable liquid, etc.). Use DOT approved labels.

NOTE: See SARP for specific requirements.

- 6. Determine the category and the security requirement if the material is SNM. (See DOE Order 5632.4.) Obtain Nuclear Materials Management Accountability review if necessary.
- 7. Determine if and when consignee can take delivery.
- 8. Schedule transportation equipment suitable for the shipment. Schedule Operational Health Physics and Patrol escorts if required.
- 9. Complete an RSR according to instructions found in Part IV, Section 2.3 that follows. This completed form must accompany the shipment to the consignee's facility, along with other pertinent papers, such as burial or storage forms (in accordance with WHC-EP-00063) and/or a list of SARP administrative controls under which the shipment must be made.
- 10. Furnish appropriate placards to the carrier (see 49 CFR Part 172 Subpart F) or if vehicle is equipped with permanent placards, assure that placards are turned to the proper hazards. All onsite radioactive shipments must be placarded in accordance with 49 CFR 172 Subpart F, or an approved alternative. See the SARP for specifics.
- 11. Supervise the loading and securing of packages into or onto the transport vehicle. Assure that riggers or truck drivers are aware of any tiedown requirements named in associated COCs, SARPs, work procedures, etc. It is the packager/shipper's responsibility to inspect and approve securing of all loads to assure tiedown requirements are met.
- 12. Assure that the carrier understands and follows all administrative controls as specified in the SARP for transport of the package(s).
- 13. Advise receiver of the ETA and request confirmation of delivery on interarea shipments exceeding Type A quantities.
- 14. Maintain a copy of the RSR for a least 3 months as a record of shipment.

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### 1.3 PREPARING ONSITE RADIOACTIVE SHIPMENT RECORDS (RSR)

The following instructions are keyed to numbered blocks on a specimen copy of the onsite RSR (Exhibit IV-1-1).

NOTE: Shipments of material via the safe secure trailer (SST) and escorted by DOE couriers are classified and are, therefore, exempt from these RSR requirements.

NOTE: Minor errors on an RSR may be corrected in the field by drawing a line through the error, entering the correction above it, and signing the shipper's authorized signature adjacent to the error/correction.

#### 1.3.1 Shipper Section Completed by Packager/Shipper

1. Check appropriate blocks based on material classification, if SNM and if security escort is required (see Security Manual). Check appropriate contractor block.
2. Identify the receiver, shipper, and carrier by name. The shipment is to be addressed to an individual whose name must appear in the proper box. The address must also include identification of the contractor/component, building, area, and phone number. The shipper's name and complete address must be provided. Also, identify the vehicle by number.
3. Give a complete description of the radioactive contents. If several similar packages are being shipped, describe the worst case situation. List radionuclides present (abbreviations from 49 CFR 173.435 are acceptable). List the maximum curie content per container, maximum grams fissile material per container, total grams fissile per shipment, and total curies per shipment.
4. Determine if material is normal form or special form (49 CFR 173.403(s) and 173.403(z)). Identify ownership of material: DOE or licensee. Check appropriate block for physical form of material (e.g., solid, liquid, or gas). Determine quantity based on form (normal or special) and curies per container. Identify chemical form of the material (e.g., oxide, chloride, etc.).
5. Give a detailed description of the packaging. List the number and types of containers. Describe each, including internal packaging (e.g., absorbent). Describe any secondary hazards (e.g., corrosives). Include model numbers, identification numbers, DOT specification numbers, etc. Sketches may be made or attached.

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		Yes	No
Classified Material			
Special Nuclear Material			
Security Escort Required			
ONSITE RADIOACTIVE SHIPMENT RECORD (Instructions For Completion On Back)			
DOE CONTRACTOR: <input type="checkbox"/> PNL <input type="checkbox"/> WHC <input type="checkbox"/> KEH			
Nº 26080			
NAME		CONTRACTOR AND COMPONENT	
To:		BUILDING AND AREA	
From:		PHONE	
Carrier:		Vehicle No.	
1.3.1 Shipper Section			
COMPLETE DESCRIPTION OF RADIOACTIVE CONTENTS:		DETAILED PACKAGING DESCRIPTION:	
Radionuclide(s):		No. Containers:	
Maximum Activity (Curies)/Container:		Type Containers:	
Grams Fissile/Container:		Description:	
Total Grams Fissile/shipment		Secondary Hazards? (List):	
Total Curies/shipment		Container Approval Document(s):	
Normal Form <input type="checkbox"/>		Shipment Number (when applicable)	
Special Form <input type="checkbox"/>		Material Is: <input type="checkbox"/> DOE <input type="checkbox"/> Licensee	
Physical Form <input type="checkbox"/> Solid <input type="checkbox"/> Gas		Container(s) <input type="checkbox"/> Single Trip <input type="checkbox"/> Reusable	
Liquid		Absorbent Material Required <input type="checkbox"/> Yes <input type="checkbox"/> NA	
QUANTITY CATEGORY		Container(s) Free of Deterioration and/or Damage <input type="checkbox"/> Yes <input type="checkbox"/> No	
<input type="checkbox"/> Limited Quantity		Labels Required <input type="checkbox"/> Yes <input type="checkbox"/> No	
<input type="checkbox"/> Low Specific Activity Material		Placards Required <input type="checkbox"/> Yes <input type="checkbox"/> No	
<input type="checkbox"/> Type A Quantity		Tiedown Verified <input type="checkbox"/> Yes <input type="checkbox"/> NA	
<input type="checkbox"/> Type B Quantity		Accountable Nuclear Material Transfer Documents <input type="checkbox"/> Yes <input type="checkbox"/> NA	
<input type="checkbox"/> Highway Route Controlled Quantity		Prepared	
Chemical Form			
<input type="checkbox"/> Oxide <input type="checkbox"/> Mixture			
<input type="checkbox"/> Nitrate <input type="checkbox"/> Organic			
<input type="checkbox"/> Elemental			
<input type="checkbox"/> Other Specify			
EXTERNAL RADIATION (mrem/hr)		REMOVABLE CONTAMINATION	
Package		Smears of Outer Container	
Vehicle		<input type="checkbox"/> $\leq 22$ or $\frac{\text{d/m } \beta\gamma}{\text{sq. cm}}$	
At Contact		<input type="checkbox"/> $\leq 2.2$ or $\frac{\text{d/m } \alpha}{\text{sq. cm}}$	
At 1 Meter			
At Sides			
2 Meter			
In Cab:			
List Other Pertinent Information:			
1.3.2 Radiation Monitoring Section			
RM Escort Required <input type="checkbox"/> Yes <input type="checkbox"/> No			
RM Supervisor Review Required <input type="checkbox"/> Yes <input type="checkbox"/> No			
Reviewed by: RM Supervisor			
Surveyed by: Radiation Monitor			
Date			
INSTRUCTIONS: 1. Speed Limit Restricted To: MPH. Never exceed posted limits.			
2. Do not leave shipment unattended between pick up and drop off points.			
3. In case of an accident or spill notify RM immediately. Phone			
4. Shipments during hazardous road conditions and/or congested traffic should be avoided.			
5. Tie down or restrain packages to prevent shifting or loss of packages during transport.			
6. Declare material and present shipment record at each patrol check point.			
7. Obtain RM release of transport vehicle after delivery of radioactive materials.			
8. Other:			
1.3.3 Carrier Section			
9. Obtain Receiver's Signature: Received by			
Date			
NOTE: Person authorizing shipment must not transport it.			
1.3.4 Certification Section			
CERTIFICATION			
This/These package(s) has/have been prepared for onsite shipment in accordance with applicable federal regulations as prescribed in DOE Order 5480.1A chapter III and its RI supplement.			
Shipping Organization Rep. Print Name Date			

(DISTRIBUTION - See Back For Instructions)

54-3000-609 (6/87)

Exhibit IV-1-1. Specimen Copy of an Onsite  
Radioactive Shipment Record (RSR).

6. List container approval documentation, e.g., SARP numbers (e.g., HCS-047-001-00), COC numbers, or the DOT specification numbers for the container's fabrication and approved loading. If the shipment is being made under an approved waiver or deviation, the waiver or deviation letter number must also be listed. The remaining questions are self-explanatory.

#### 1.3.2 Radiation Monitoring Section Completed By Radiation Protection Technologist

1. Radiation survey data for the package(s) and the vehicle are recorded here. The RPT signs and dates the form.

NOTE: The RPT will retain the white copy of the RSR in the RPT office however, the RPT shall not remove the white copy until the shipment is completely packaged and the shipper has certified the shipment. The white copies are later collected by Traffic and retained.

#### 1.3.3 Carrier Section Completed By Packager/Shipper

1. Shipper must record any speed limit restrictions required by SARP and list the Radiation Monitoring emergency number. The shipper should list or reference any additional administrative controls or security requirements that must be followed by the carrier. Any radiation dose rate that exceeds the DOT limit of 200 mr/hr at package surface must be specifically authorized in the SARP. For dose rates exceeding 1 rem/hr at three feet OHP must concur prior to shipment. The shipper must notify Packaging Development that the SARP limits were exceeded. The receiver must concur with conditions of shipment prior to shipment.

NOTE: The carrier must obtain a signature from the consignee indicating acceptance of the shipment. This must be done before the shipment can be considered complete.

#### 1.3.4 Certification Section Completed By Certifier

1. An authorized and delegated shipping organization representative must sign and date the form, certifying that the shipment meets DOE-RL and contractor shipping requirements. The authorizing signature must be one of a delegated employee who has passed the "Certification of Hazardous Material Shipments" course. Retraining in this course is required every 2 years to retain signature authorization.

NOTE: Instructions are printed on the reverse side of the RSR for disposition of copies.

#### 1.4 ONSITE ROUTINE RADIOACTIVE SHIPMENTS

Certain onsite radioactive material shipments; such as sealed sources, environmental and process samples, and low level waste not exceeding Type A; due to their frequency and uniformity of contents and packaging are considered routine. The safety record for these shipments is well established and supports their movement and documentation by use of an Onsite Routine Radioactive Shipment Record (ORRSR).

Limits, requirements, supporting documentation and qualification of personnel will be determined by Operations Manager, Radiological Assessment/Packaging & Shipping, Operational Health Physics and Traffic. Limits shall not exceed those specified in the Package Approval document.

The ORRSR shall be a documented record of all routine type shipments and used only for the shipment of radioactive material as described therein. Use of the ORRSR gives a considerable time savings and convenience in shipping activities, however, violation of the shipment conditions stated will result in withdrawal of the ORRSR and issuance of an Event Fact Sheet.

Two variations of the ORRSR form are used (Exhibit IV-1-2 and IV-1-3, Form Numbers WHCM 8708-002.1 and WHCM 8708-002.2) depending on the quantity and type of radioactive material shipped and the shipment certification needed.

The Routine Authorization Form (Exhibit IV-1-2) is authorized by Traffic after review and approvals are received from Operational Health Physics (OHP), Operations Managers and Radiological Assessment/Packaging & Shipping (RA/P&S). The Traffic approval authorizes qualified personnel (See 1.4.1, Step 9 below) as well as authorized shippers to certify that the shipments meets all the requirements as set forth on the ORRSR and that the package meets applicable requirements for onsite shipments. In most cases this will be limited to Limited Quantity, LSA, or Types A and B special forms only.

The Authorized Shipper form (Exhibit IV-1-3) is to be used for routine shipments up through Type A quantities. This form requires that each shipment be reviewed and certified by an authorized hazardous materials shipper. Limits shall be as determined by the approval organization.

##### 1.4.1 How To Obtain An ORRSR

The Operating Organization will prepare a draft ORRSR (new or renewal) in accordance with the following instructions and forward it to Traffic to initiate the review and approval cycle. Step by step instructions keyed to Exhibits IV-1-2 and IV-1-3 are as follows:

1. FOR THE SHIPMENT OF Use the proper shipping name of the material and package description (Model, etc.), including its approval document number (DOE/NRC COC, DOT Specification or Exemption, SARP, etc.) that will help identify the shipment.

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DOE CONTRACTOR WESTINGHOUSE HANFORD COMPANY		COPY NO. 4
FOR THE SHIPMENT OF 1		VOID DATE 5
BETWEEN 2		NO INSPECTION UNCLASSIFIED
DESCRIPTION OF RADIOACTIVE CONTENTS: RADIOISOTOPES 6 ACTIVITY (MAX) FISSILE (GRAMS) PHYSICAL FORM FORM - NORMAL <input type="checkbox"/> CHEMICAL FORM SPECIAL <input type="checkbox"/> QUANTITY SECONDARY HAZARD		PACKAGE REQUIREMENTS 7  APPROVAL DOCUMENT(S): QA INSPECTION:
RADIOLOGICAL PROTECTION REQUIREMENTS 8  LABEL(S) REQUIRED PHONES - RWPS -		QUALIFIED PERSONNEL - to package and ship 9  PHONES
SPECIAL REQUIREMENTS 10		
CARRIER INSTRUCTIONS 11 1. <input type="checkbox"/> SPEED LIMIT RESTRICTED TO: _____ MPH. NEVER EXCEED POSTED LIMITS. 2. <input type="checkbox"/> DO NOT LEAVE SHIPMENT UNATTENDED BETWEEN PICK UP AND DROP OFF POINTS. 3. <input type="checkbox"/> IN CASE OF ACCIDENT OR SPILL NOTIFY RPT IMMEDIATELY. CALL 811 4. <input type="checkbox"/> SHIPMENTS DURING HAZARDOUS ROAD CONDITIONS AND/OR CONGESTED TRAFFIC SHOULD BE AVOIDED. 5. <input type="checkbox"/> TIE DOWN OR RESTRAIN PACKAGES TO PREVENT SHIFTING OR LOSS OF PACKAGES DURING TRANSPORT. 6. <input type="checkbox"/> DECLARE MATERIAL AND PRESENT SHIPMENT RECORD AT EACH PATROL CHECK POINT. 7. <input type="checkbox"/> OBTAIN RPT RELEASE OF TRANSPORT VEHICLE AFTER DELIVERY OF RADIOACTIVE MATERIALS. 8. <input type="checkbox"/> PLACARD(S) REQUIRED.		
THE ABOVE LISTED QUALIFIED PERSONNEL ARE AUTHORIZED TO CERTIFY THIS SHIPMENT ROUTINE AUTHORIZATION 12 _____ AUTHORIZED SIGNATURE _____ PRINT NAME _____ DATE		
APPROVALS 14		
ORIGINATOR	DATE	TRAFFIC
OPERATIONS MANAGER	DATE	RADIOLOGICAL ASSESSMENT & PACKAGING/SHIPPING
OPERATIONS MANAGER	DATE	OPERATIONAL HEALTH PHYSICS

WHCM 8708-002.1

Exhibit IV-1-2. Specimen Copy of Qualified Shipper ORRSR.

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Only BLUE copy valid for shipment

ONSITE ROUTINE RADIOACTIVE SHIPMENT RECORD		NO. 3
DOE CONTRACTOR WESTINGHOUSE HANFORD COMPANY		COPY NO. 4
FOR THE SHIPMENT OF 1		VOID DATE 5
BETWEEN 2		NO INSPECTION UNCLASSIFIED
<b>DESCRIPTION OF RADIOACTIVE CONTENTS:</b> RADIOISOTOPES 6  ACTIVITY (MAX)      FISSIONABLE (GRAMS) PHYSICAL FORM FORM - NORMAL <input type="checkbox"/> CHEMICAL FORM SPECIAL <input type="checkbox"/> QUANTITY  SECONDARY HAZARD		<b>PACKAGE REQUIREMENTS</b>  7  APPROVAL DOCUMENT(S): QA INSPECTION:
<b>RADIOLOGICAL PROTECTION REQUIREMENTS</b>  8  LABEL(S) REQUIRED PHONES - RWPS -		<b>QUALIFIED PERSONNEL</b> - to package and ship  9  PHONES
<b>SPECIAL REQUIREMENTS</b>  10		
<b>CARRIER INSTRUCTIONS</b> 11 1. <input type="checkbox"/> SPEED LIMIT RESTRICTED TO: _____ MPH. NEVER EXCEED POSTED LIMITS. 2. <input type="checkbox"/> DO NOT LEAVE SHIPMENT UNATTENDED BETWEEN PICK UP AND DROP OFF POINTS. 3. <input type="checkbox"/> IN CASE OF ACCIDENT OR SPILL, NOTIFY RPT IMMEDIATELY. CALL 811 4. <input type="checkbox"/> SHIPMENTS DURING HAZARDOUS ROAD CONDITIONS AND/OR CONGESTED TRAFFIC SHOULD BE AVOIDED. 5. <input type="checkbox"/> TIE DOWN OR RESTRAIN PACKAGES TO PREVENT SHIFTING OR LOSS OF PACKAGES DURING TRANSPORT. 6. <input type="checkbox"/> DECLARE MATERIAL AND PRESENT SHIPMENT RECORD AT EACH PATROL CHECK POINT. 7. <input type="checkbox"/> OBTAIN RPT RELEASE OF TRANSPORT VEHICLE AFTER DELIVERY OF RADIOACTIVE MATERIALS. 8. <input type="checkbox"/> PLACARD(S) REQUIRED.		
13 <b>AUTHORIZED SHIPPER</b> to Certify on reverse side		
<b>APPROVALS</b> 14		
ORIGINATOR	DATE	TRAFFIC DATE
OPERATIONS MANAGER	DATE	RADIOLOGICAL ASSESSMENT & PACKAGING/SHIPPING DATE
OPERATIONS MANAGER	DATE	OPERATIONAL HEALTH PHYSICS DATE

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2. BETWEEN List buildings and areas that shipment will be going to and from. If several areas are involved it may be "All Areas Hanford Site". The buildings and areas will be recorded on the shipment record.
3. NO. Each routine will be assigned an identifying number by area, year and operations group by Traffic.
4. COPY NO. The Blue card stock, working copies will be prenumbered before issued by Traffic. The originator is responsible to ensure that adequate supplies of ORRSRs are issued and maintained so not to affect operations when the Shipment Record portion on the reverse side is completed. Completed ORRSRs should be returned to Traffic immediately.

Upon revision of the ORRSR, all previous copies still in the field should be recalled by the originator and returned to Traffic for accountability.

5. VOID DATE The ORRSR is void on date shown. This date will never be over one year from date of issue.
6. DESCRIPTION OF RADIOACTIVE CONTENTS The originator shall identify activity/quantity limits for each radionuclide to be shipped based on calibration, characterization or calculation.
7. PACKAGE REQUIREMENTS Descriptions of containment and package. List all approval documents relating to the container and procedures used by Operations personnel.
8. RADIOLOGICAL PROTECTION REQUIREMENTS The radiation limits set here are the limits for the package described on the ORRSR. If the limits are exceeded, the package must be shipped on an Onsite RSR, requiring approval by an authorized shipper.

All labeling shall meet DOT transportation regulations unless the SARP specifies otherwise. Secondary hazard class labels shall be used when appropriate.

List of any RWPs related to packaging, handling, shipping and transporting, for both the shipper and receiver.

9. QUALIFIED PERSONNEL Qualification of personnel is a determination that knowledge and abilities gained through training and experience, measured against established requirements, standards, procedures or tests, qualify an individual to perform a required function in a safe and proficient manner. In all cases, the determination of personnel qualification is by their responsible manager and his approval on the ORRSR. Auditable records documenting that only qualified individuals are assigned to organizational shipping responsibilities are required.

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10. SPECIAL REQUIREMENTS Special instructions including specific tiedown requirements, if applicable, should be specified.
11. CARRIER INSTRUCTIONS Check each requirement for the carrier's attention. Special instructions should appear above.
12. ROUTINE AUTHORIZATION ORRSRs of this type (Exhibit IV-1-2) discussed above are authorized by Traffic after other approvals are done. Qualified personnel may certify these shipments on reverse side.
13. AUTHORIZED SHIPPER ORRSRs of this type (Exhibit IV-1-3) discussed above require review and certification signatures of authorized shippers for each shipment on the reverse side.
14. APPROVALS The routine will be reviewed and approved periodically on a case-by-case basis. Approvals are required by all organizations listed on the form.

ORIGINATOR shall be the central contact for the ORRSR to control the copies being used and assure proper use of them.

OPERATIONS MANAGER shall be the responsible manager of the qualified personnel and the material being shipped. The shipping manager and the receiving manager shall approve.

RADIOLOGICAL ASSESSMENT/PACKAGING & SHIPPING must review and approve.

OPERATIONAL HEALTH PHYSICS must review and approve radiological conditions set forth.

TRAFFIC must review and approve.

1.4.2 Use Of The ORRSR

Shipment Logs particular to each of the two types of ORRSRs are imprinted on the reverse side and are shown here for comparison (Exhibits IV-1-4 and IV-1-5).

Exhibit IV-1-4 is the Shipment Log appearing on the back of the "Routine Authorization" ORRSR (Exhibit IV-1-2) and allows qualified personnel, designated on the front, to certify a shipment.

Exhibit IV-1-5 is the Shipment Log appearing on the back of the "Authorized Shipper" ORRSR (Exhibit IV-1-3). In this case each shipment must be certified by an authorized shipper.





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Exhibit IV-1-5. Shipment Log, Reverse Side of Authorized Shipper ORRSR.

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Each shipment shall be documented by entering the required information onto a single line of the Shipment Log. When all the lines of the log are filled return the ORRSR to Traffic for a replacement. The Shipment Log is the instrument used to give Traffic a degree of control and to determine the frequency of use and need for each ORRSR.

## 2.0 MISCELLANEOUS RADIOACTIVE MATERIAL SHIPMENTS

### 2.1 FISSILE MATERIAL AND SPECIAL NUCLEAR MATERIAL

The shipment of fissile materials requires certain controls in addition to those needed for nonfissile radioactive material. Fissile materials require controls for criticality safety and accountability and since all DOT designated fissile materials are also special nuclear materials (SNM) of national strategic importance, additional controls for security and safeguards are also mandatory.

NOTE: In the Atomic Energy Act, the term SNM refers to any isotope of plutonium, uranium-233, uranium-235, uranium containing more than the normal abundance of uranium-235, or any material artificially enriched in any of these substances. Specifically, fissile isotopes are those capable of sustaining a nuclear chain reaction with thermal (slow) neutrons (e.g.  $^{235}\text{U}$ ,  $^{239}\text{Pu}$ ,  $^{241}\text{Pu}$ , and  $^{233}\text{U}$ ), while fissionable isotopes are those capable of sustaining a nuclear chain reaction by fast or thermal neutrons (e.g.  $^{238}\text{Pu}$ ,  $^{240}\text{Pu}$ ,  $^{237}\text{Np}$ ,  $^{244}\text{Cm}$ ,  $^{241}\text{Am}$ , etc.). For purposes of this manual, the term "fissile" will include fissionable material as well as fissile.

#### 2.1.1 Fissile Exempt Material - Onsite/Offsite Shipment

Fissile material is classified as either fissile or fissile exempt material. Fissile exempt material is exempted from criticality safety packaging requirements. These shipments must still be in accordance with both shipping and receiving facility fissionable material limits and restrictions. The most common exemption is no more than 15g fissile material in a package. If material is transported in bulk the 15g limitation applies to the conveyance. Additional fissile material exemptions are given in 49 CFR 173.453.

All fissile material, whether exempt or not, is subject to the same packaging and shipping regulations as nonfissile radioactive material, and must also be characterized as Limited Quantity, Type A, Type B, or Highway Route Controlled Quantity (HRCQ), and shipped in containers approved for those quantities.

### 2.1.2 Fissile Material Offsite/Onsite Shipments

All offsite shipments (>15g) of fissile material shall be packaged either in DOT Specification containers consistent with 49 CFR 173.417 or in containers approved by DOE or NRC for transportation of fissionable material. Approved containers do not require additional criticality safety reviews.

Offsite shipments shall be in accordance with the container Certificate of Compliance or as specifically described in 49 CFR for DOT specification containers. This certificate shall be posted or readily available within the loading areas and any place where fissile material is stored in the container. The Transport Index shall be posted on the container.

All onsite shipments (>15g) of fissile material not packaged in offsite containers shall be packaged in containers reviewed and approved by the WHC Approval Authority and DOE-RL, when applicable. Safety shall review onsite containers for criticality safety concerns. Onsite container design when coupled with other considerations shall provide criticality safety protection consistent with protection provided by approved offsite containers.

Onsite shipments shall be made in accordance with both shipping and receiving facility Criticality Safety Specifications or facility fissile material status and the container authorized fissile contents based on the container SARP. The container SARP shall be available for use within the loading and unloading areas or any place where fissionable material is stored in the container.

### 2.1.3 Fissile Classes

Packages of fissile radioactive material are classed as Fissile Classes I, II, or III depending on the degree of control needed to provide nuclear criticality safety during handling and shipping. Criticality Safety Analysis, performed and documented in a SARP, COC or 49 CFR 173.417, determines the fissile class to be applied to a package for shipment of fissile material. Fissile classes are defined in 49 CFR 173.455.

### 2.1.4 Accountable Material

#### 2.1.4.1 Accountability

Accountability is materials management based on nuclear materials accounting control including the documentation of all transactions and adjustments that affect the materials balance, material usage and the preparation of inventory reports. Accountable Materials, consistent with DOE Safeguards and Security Division recommendations and with WHC usage, include radionuclides grouped according to their origins, uses and properties and referred to by a variety of terms:

- o Nuclear Materials
- o Source Materials

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- o Special Nuclear Materials

Accountable Nuclear Materials defined by DOE Order 5630.2<sup>(2)</sup> are:

- o Uranium, natural, depleted, enriched <20%, ≥20% U-235
- o Plutonium, all isotopes
- o Americium-241, -243
- o Curium
- o Berkelium
- o Californium
- o Lithium-6
- o Uranium-233
- o Neptunium-237
- o Deuterium
- o Tritium
- o Thorium

### 2.1.5 Approvals for Offsite Shipments of Radioactive Material

Offsite shipments and certain onsite movements of any radioactive material, whether accountable or not, require approval by Safeguards and DOE-RL. Nonaccountable radioactive material shipments and some small amounts of accountables are generally covered by a blanket approval obtained at the beginning of each fiscal year; approvals for larger amounts of accountable materials are generated on a case-by-case basis.

The shipment originator initiates application for approval by submitting a Radioactive Material Action Request (BD-7200-035) to Safeguards. Safeguards reviews the request and submits it to DOE/RL for approval.

The Nuclear Material Control and Accountability Manual, WHC-CM-4-34, gives guidance for generating the approval request and the correct accountability forms.

## RADIOACTIVE MATERIAL SHIPMENTS

2.1.6 Categorization and Physical Protection for SNM Shipments

Offsite shipments of SNM must comply with the physical protection requirements of 10 CFR, Energy; 49 CFR, Transportation; and DOE Order 5632.4, "Physical Protection of Security Interests".

Onsite shipments of SNM must comply with these same regulations as well as MRP 5.27, "Movement of Radioactive Material" and WHC-0076, Rev. 2, Classified, Secret, "Hanford Intrasite Shipments of SNM by Rail or Wheeled Vehicle Security Plan." These two latter onsite documents may contain more stringent requirements than those for offsite and should be inspected closely to prevent shipping problems.

Whether onsite or offsite, the degree of security imposed on the shipments is determined by the category amounts of SNM defined in DOE Order 5632.4. Table IV-2-1 defines the SNM categories. Chapter VI of DOE Order 5632.4 defines the minimum requirements for safeguarding SNM by categories while in transit.

Table IV-2-1

PHYSICAL PROTECTION  
CATEGORIZATION OF NUCLEAR MATERIAL

Special Nuclear Material	Category <sup>1/</sup> I	Category <sup>1/</sup> II	Category <sup>2/</sup> III-A	Category III-B
Plutonium	2 kg or more	400-1,999 grams	220-399 grams	1-219 grams
Uranium-233	2 kg or more	400-1,999 grams	220-399 grams	1-219 grams
Uranium-235 (Contained in Uranium enriched to 20% or more)	5 kg or more	1,000-4,999 grams	350-999 grams	1-349 grams
Uranium-235 (Contained in Uranium enriched to less than 20%)	---	---	---	All quantities one gram or more

<sup>1/</sup> If Plutonium or Uranium-233 is combined with Uranium-235, the amounts of Plutonium or Uranium-233 must be normalized to the U-235 content by multiplying by 2.5 to arrive at the category limits shown.

<sup>2/</sup> A Plutonium and/or Uranium-233 content of less than 400 grams may be combined with Uranium-235 when the total content is less than 1,000 grams.

Documentation for Category I shipments is classified. Certain Category II shipments may be classified depending on the material, and the above documents.

#### 2.1.7 Security Exemptions for Onsite Shipments of SNM

1. Plutonium contained with other materials, the aggregate of which is defined as waste, and transported wholly within the confines of a limited area, is exempt from requirements for patrol escort and use of a dedicated Equipment Operations vehicle.
2. Plutonium not readily separable from other radioactive material, the combination of which delivers an external radiation dose in excess of 100 rem/at 3 ft without intervening shielding, is exempt from these physical protection requirements.
3. Plutonium in quantities >2 kg transported between the 324, 325 or 308 Buildings (within the 308 Protected Area) is exempt from the physical protection guidelines. The two-man rule plus one patrolman applies. An Equipment Operations vehicle not required.
4. If WHC cannot provide the required physical protection for a shipment of SNM that would seriously impact operations, the requirements for use of a dedicated vehicle may be waived by DOE-RL.

#### 2.2 RADIOACTIVE MIXED WASTE

Radioactive mixed wastes are radioactive wastes that also exhibit other hazardous characteristics or are cross-contaminated with materials or wastes that are hazardous as defined in 40 CFR Parts 260-265, 49 CFR Parts 171-179 and/or Washington Administrative Code (WAC) 173-303. Radioactive mixed wastes are regulated jointly under the Atomic Energy Act (AEA) and the Resource Conservation Recovery Act (RCRA), and as such, must be packaged, shipped and disposed of in accordance with the regulations established under these two Federal laws.

Based on these laws and regulations established to enforce them, it is mandatory that radioactive mixed wastes be packaged and shipped onsite and/or offsite in accordance with DOT Hazardous Material Regulations as set forth in 49 CFR Parts 171-179. Certain exceptions may be granted by applying for a DOT exemption for offsite shipments or a DOE Headquarters alternative or DOE field office exception for onsite shipments (see DOE Order 1540.2 for administrative procedures that apply). Remember that DOE policy is that these options not be used unless extraordinary circumstances exist that would justify noncompliance to established regulations.

Radioactive mixed waste at Hanford must be prepared for storage or disposal in accordance with WHC-EP-00063, "Hanford Radioactive Solid Waste Packaging, Storage and Disposal Requirements" as applicable.

Radioactive mixed wastes at Hanford must be shipped in accordance with applicable DOT regulations or under a DOE approved alternative which is formally documented and provides an equivalent degree of safety. Shipping paper documentation of radioactive mixed waste shipments must consist of radioactive shipment records (RSRs) and uniform hazardous waste manifests (UHWs) when required for the type and quantity of material being shipped. For examples of this documentation, see Sections III-3.0, III-4.0, IV-2.3 and IV-4.3.

## 2.3 CONTROLLED VEHICLES

Certain onsite movements of radioactive material contamination do not qualify as radioactive material shipments and therefore are not documented with an onsite RSR or onsite routine RSR. These are movements of controlled vehicles and regulated vehicles that cannot be unconditionally released. These are covered on a Radiation Work Permit (RWP). Radiation Protection, WHC-CM-4-10, defines these vehicles in sections 7.4.4.13 and 7.4.16 and shows the appropriate signs or stickers for each.

## 3.0 OFFSITE SHIPPING PROCEDURES

### 3.1. SHIPPER'S RESPONSIBILITIES

The delegated/authorized hazardous materials shipper who prepares packages of radioactive material for offsite shipment is responsible for the following functions:

1. Verifying that the consignee has a license (specific or general) to receive and process the type of radioactive material to be shipped. This check is required whenever the consignee is not a license-exempt DOE contractor.
2. Properly classifying, describing, packaging, marking, and labeling the radioactive material for offsite shipment in a manner that complies with applicable government (Federal, state, local) regulations (e.g., Title 49 CFR Parts 171-179, DOE Order 5480.3).
3. Properly completing an Offsite Radioactive Shipment Record (ORSR) form for each shipment.
4. Notifying Traffic of the following items in advance of shipment:
  - a. The date the shipment will be packaged and ready for transport
  - b. The proper shipping name, hazard class, and the United Nations/North American (UN/NA) number
  - c. The radionuclides and quantity (curies and grams) of material to be shipped and for fissile material, the fissile class assigned to each package.



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- d. The number and types of packages used. Each package description should include the U.S. Department of Transportation (DOT) specification or Certificate of Compliance (COC) number, as appropriate, and its size and weight.
- e. All special considerations such as suggested routings, mode of transport, special vehicle requirements, safeguards and security, destination, requested delivery dates, and any other pertinent information concerning the shipment.

NOTE: A one day advance notice of shipment is a minimum requirement and that special shipments (e.g., exports, exclusive-use, safe secure trailer (SST), etc.) require longer lead times. As example, irradiated reactor fuel shipments require that a physical protection plan be developed and approved before shipment (49 CFR 173.22(b)). This may take some time to complete. Another example, a Highway Route Controlled Quantity (HRCQ) radioactive shipment requires special routing and the filing of a route plan, as well as submittal of additional information (49 CFR 173.22(c)). The manager who arranges for the offsite shipment of a HRCQ must provide the necessary data to Traffic 60 days prior to the first shipment. Additional guidance is given in Appendix D.

NOTE: Prenotification must be made to the states that shipments of spent fuel or high level waste pass through, requiring additional time. The manager who intends to ship either unclassified spent fuel or high level radioactive waste offsite must submit the necessary information to Traffic at least two weeks prior to the shipment for concurrence and subsequent transmittal to DOE-RL. Additional guidance is given in Appendix D.

5. Scheduling onsite transportation with Heavy Equipment Operations from the packager's site to the 1167 Building of less than truckload shipments, including Category III quantities of Special Nuclear Material (SNM). Assure, prior to loading, the transport vehicle/trailer is visually inspected and the Class A/B preventative maintenance is current.

NOTE: No SNM can be stored overnight in the 1100 area. Traffic must be notified in advance of any shipment of SNM to ensure a timely departure from Hanford. Otherwise, the shipment will be returned to the shipper until proper procedures are followed.

6. Scheduling in advance, Category II shipments of SNM through Traffic to assure availability of equipment and properly cleared drivers.
7. Scheduling in advance Category I shipments of SNM and "cargos of opportunity" with Traffic for movement in the SST system operated by the Albuquerque Operations Office-Transportation Safeguards Division (ALO-TSD).

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8. Requesting in advance that Traffic schedule commercial carriers to load exclusive-use or full-load shipments of radioactive materials at the packager's site.
9. Delivering the completed ORSR form to the truck driver or train engineer making the onsite transfer to the 1167 Building or to the Traffic representative who may witness the loading of an exclusive-use vehicle at the packager's site.
10. Inspecting and approving tiedown systems used to secure loads to the transport equipment. Note that tiedown system approval responsibilities are shared with other functional groups, depending on the type of shipment and method of transport.
11. Assuring that transport vehicles are placarded for the appropriate hazards as required by the regulations (49 CFR 172 Subpart F).
12. Maintaining for at least one year a file of supporting documentation used as a basis for making the shipment (e.g., current COC, Safety Analysis Report for Packaging (SARP), etc.). Assure all appropriate internal procedures reflect the requirements of these documents prior to making the initial shipment.

### 3.2 GENERAL PROCEDURE FOR OFFSITE RADIOACTIVE MATERIAL SHIPMENTS

This section describes in general terms the actions required to prepare radioactive material for transportation offsite. A schematic illustration of this process is given in Figure IV-3-1.

NOTE: Specific operating procedures prepared and controlled by Process Engineering shall be followed when preparing a shipment, in addition to this general procedure.

#### 3.2.1 Definition of Material

Define the material to be shipped in the following manner.

1. List the radionuclides that are present (e.g.,  $^{239}\text{Pu}$ ,  $^{233}\text{U}$ , and  $^{137}\text{Cs}$ ).
2. Determine the level of radioactivity present in terms of curies. If fissile radioactive material (49 CFR 173.403(j)), also determine fissile quantity in terms of grams. Determine if the material qualifies as a hazardous substance, RQ, see 171.8 and 171.101 Appendix.
3. Determine if material will be shipped as normal form or special form (49 CFR 173.403(s) and (z)).

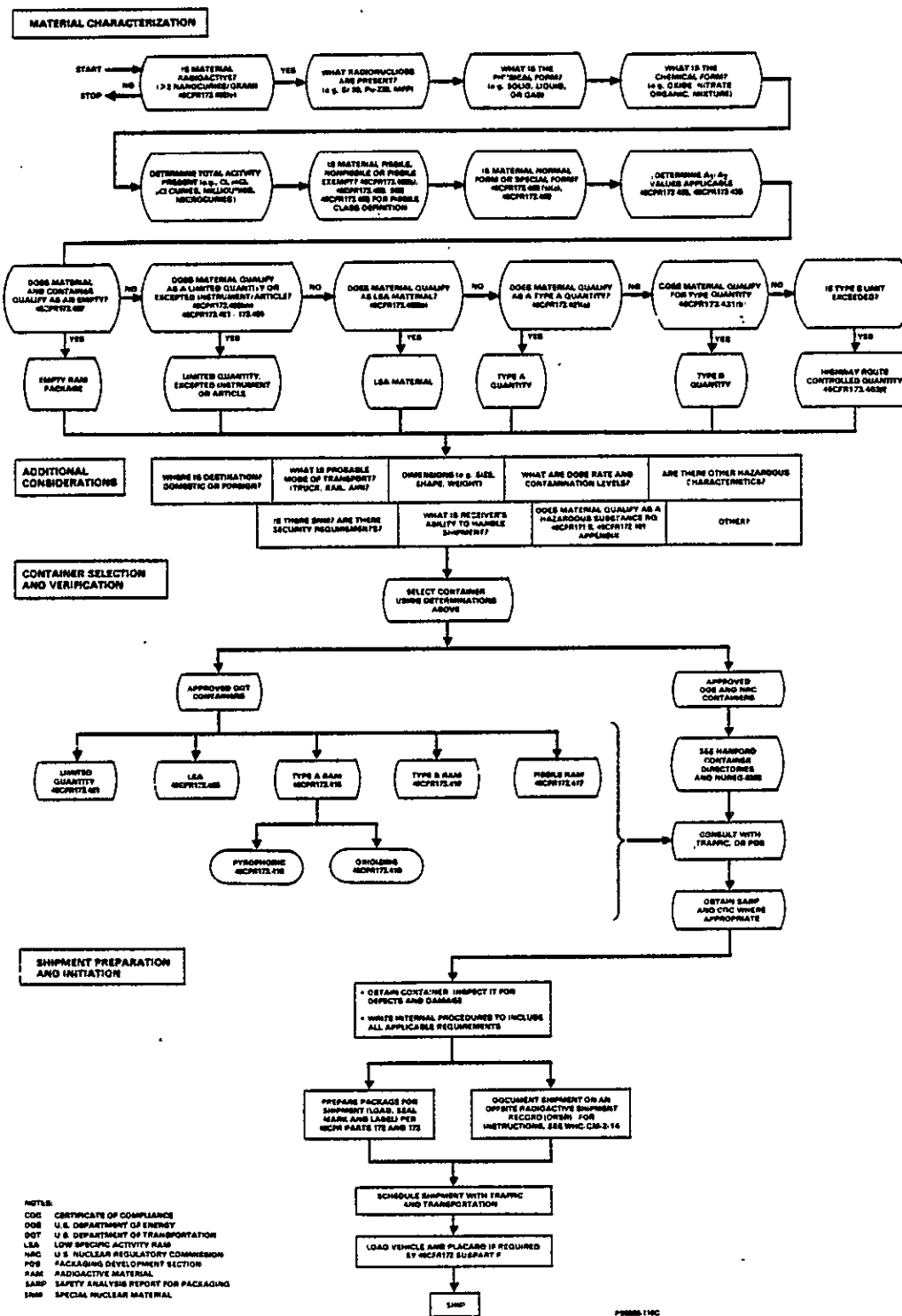


Figure IV-3-1. Offsite Radioactive Material Shippers Guide.

## RADIOACTIVE MATERIAL SHIPMENTS

4. If normal form, determine the physical form (e.g., solid, liquid, or gas) and the chemical form (e.g., nitrate, oxide, elemental, etc.) of the radioactive material.
5. Determine if other hazardous materials are present or if other hazardous characteristics are exhibited (e.g., corrosive, flammable liquid, oxidizing materials, etc.).
6. Identify appropriate  $A_1$  or  $A_2$  values for radionuclides contained.
  - a. Determine  $A_1$  values for radionuclides in special form (49 CFR 173.433, 173.435).
  - b. Determine  $A_2$  values for radionuclides in normal form (49 CFR 173.433, 173.435).

NOTE: Tables IV-3-1 and IV-3-2 list  $A_1$  and  $A_2$  values for commonly shipped radionuclides in special form and normal form, respectively.

7. Determine quantity category. Quantity category is based on the radionuclides contained, their  $A_1$  or  $A_2$  values as appropriate, and the number of curies to be packaged in each container (e.g., cask, box, drum). See the following sections of CFR for the quantities listed.
  - o LSA Material, 49 CFR 173.403(n)
  - o Limited quantity, 49 CFR 173.403(m) and 49 CFR 173.421-.424
  - o Type A Quantity, 49 CFR 173.431(a)
  - o Type B Quantity, 49 CFR 173.431(b)
  - o HRCQ, 49 CFR 173.403.(1)

NOTE: Tables IV-3-1 and IV-3-2 list limiting values for each category, in terms of curies, for commonly shipped radionuclides in special form and normal form, respectively.

### 3.2.2 Shipping Containers, Packaging and Transport

1. Select a shipping container based on the following considerations:
  - a. The determinations of Section 3.2.1
  - b. Need for shielding and/or cooling
  - c. Size, shape, and weight of material to be shipped

Quantity Category	Limited Quantity <sup>2,3</sup>	Type A Quantity <sup>2,4</sup>	Type B Quantity <sup>5</sup>	HRCQ <sup>6</sup>	Low Specific Activity Material LSA <sup>7</sup>
Radionuclides	$\leq 10^{-3} A_1$	$\leq A_1$	$> A_1$	$\geq 3,000 \times A_1$	Activity program of matrix
<sup>241</sup> Am	0.008	8	$> 8$	24,000	N/A
<sup>243</sup> Am	0.008	8	$> 8$	24,000	N/A
<sup>14</sup> C	1	1,000	$> 1,000$	30,000	N/A
<sup>60</sup> Co	0.007	7	$> 7$	21,000	N/A
<sup>137</sup> Cs	0.03	30	$> 30$	30,000	N/A
<sup>238</sup> Pu	0.003	3	$> 3$	9,000	N/A
<sup>239</sup> Pu	0.002	2	$> 2$	6,000	N/A
<sup>240</sup> Pu	0.002	2	$> 2$	6,000	N/A
<sup>241</sup> Pu	1	1,000	$> 1,000$	30,000	N/A
<sup>242</sup> Pu	0.003	3	$> 3$	9,000	N/A
<sup>89</sup> Sr	0.1	100	$> 100$	30,000	N/A
<sup>90</sup> Sr	0.01	10	$> 10$	30,000	N/A
M.F.P.	0.01	10	$> 10$	30,000	N/A
<sup>233</sup> U	0.1	100	$> 100$	30,000	N/A
<sup>235</sup> U	0.1	100	$> 100$	30,000	N/A
<sup>238</sup> U	Unlimited	Unlimited	Unlimited	30,000	N/A
U <sub>(NAT)</sub>	Unlimited	Unlimited	Unlimited	30,000	N/A
U <sub>(ENR &lt; 28%)</sub>	Unlimited	Unlimited	Unlimited	30,000	N/A
U <sub>(ENR &gt; 28%)</sub>	0.1	100	$> 100$	30,000	N/A
U <sub>(depleted)</sub>	Unlimited	Unlimited	Unlimited	30,000	N/A

NOTE: All values listed are in curies (Ci) unless otherwise stated.

<sup>1</sup>For mixtures of radionuclides, the most restrictive values for any one member of the mixture, establishes the mixture limiting values. [Exceptions, see 49CFR 173.433(b)].

<sup>2</sup>All values indicated, limit the activity within a given package.

<sup>3</sup>For excepted instruments and articles see 49CFR 173.422, 173.423, 173.424.

<sup>4</sup>Maximum activity values, if exceeded are Type B Quantity.

<sup>5</sup>Package contents, restricted by Package Approval Documents only (e.g., SARP, CQC).

<sup>6</sup>Highway Route Controlled Quantity (HRCQ) (Minimum values listed).

<sup>7</sup>Not applicable to special form material.

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Table IV-3-1. Activity Limits for Commonly Shipped  
Radionuclides<sup>1</sup> in Special Form

Quantity Category  Radionuclides	Limited Quantity <sup>2,3,4</sup>	Type A Quantity <sup>2,5</sup>	Type B Quantity <sup>6</sup>	HRCQ <sup>6,7</sup>	Low Specific Activity Material LSA <sup>8</sup>
	$\leq 10^{-3} A_2$	$\leq A_2$	$> A_2$	$\geq 3,000 \times A_2$	Activity per gram of matrix
<sup>241</sup> Am	0.008mCi	0.008	$> 0.008$	24	0.0001 mCi/g
<sup>243</sup> Am	0.008mCi	0.008	$> 0.008$	24	0.0001 mCi/g
<sup>14</sup> C	0.06	60	$> 60$	30,000	0.3 mCi/g
<sup>60</sup> Co	0.007	7	$> 7$	21,000	0.3 mCi/g
<sup>137</sup> Cs	0.01	10	$> 10$	30,000	0.3 mCi/g
<sup>238</sup> Pu	0.003mCi	0.003	$> 0.003$	9	0.0001 mCi/g
<sup>239</sup> Pu	0.002mCi	0.002	$> 0.002$	6	0.0001 mCi/g
<sup>240</sup> Pu	0.002mCi	0.002	$> 0.002$	6	0.0001 mCi/g
<sup>241</sup> Pu	0.1mCi	0.1	$> 0.1$	300	0.005 mCi/g
<sup>242</sup> Pu	0.003mCi	0.003	$> 0.003$	9	0.0001 mCi/g
<sup>89</sup> Sr	0.01	10	$> 10$	30,000	0.3 mCi/g
<sup>90</sup> Sr	0.4mCi	0.4	$> 0.4$	1,200	0.005 mCi/g
M.F.P.	0.4mCi	0.4	$> 0.4$	1,200	0.005 mCi/g
<sup>233</sup> U	0.1mCi	0.1	$> 0.1$	300	0.005 mCi/g
<sup>235</sup> U	0.2mCi	0.2	$> 0.2$	600	0.005 mCi/g
<sup>238</sup> U	Unlimited	Unlimited	Unlimited	30,000	Unlimited
U <sub>(NAT)</sub>	Unlimited	Unlimited	Unlimited	30,000	Unlimited
U <sub>(ENR &lt; 20%)</sub>	Unlimited	Unlimited	Unlimited	30,000	Unlimited
U <sub>(ENR &gt; 20%)</sub>	0.1mCi	0.1	$> 0.1$	300	0.005 mCi/g
U <sub>(depleted)</sub>	Unlimited	Unlimited	Unlimited	30,000	Unlimited

NOTE: All values listed are in curies (Ci) unless otherwise stated.

<sup>1</sup>For mixtures of radionuclides, the most restrictive values for any one member of the mixture, establishes the mixture limiting values. [Exceptions, see 49CFR 173.433(b)].

<sup>2</sup>All values indicated, limit the activity within a given package.

<sup>3</sup>Values shown for solids and gases. For liquids divide value shown by 10.

<sup>4</sup>For excepted instruments and articles see 49CFR 173.422, 173.423, 173.424.

<sup>5</sup>Maximum activity values, if exceeded are Type B Quantity.

<sup>6</sup>Package contents, restricted by Package Approval documents only (e.g., SARP, COC).

<sup>7</sup>Highway Route Controlled Quantity (HRCQ) (Minimum values listed).

<sup>8</sup>See 49CFR 173.403(n) for additional specific criteria.

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Table IV-3-2. Activity Limits for Commonly Shipped  
Radionuclides<sup>1</sup> in Normal Form.

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- d. Destination, mode of transport, and consignee's ability to handle the receipt of the shipment
- e. Availability of shipping containers
- f. Regulations found in 49 CFR 173.400-478 and DOE Order 5480.3.

The "Hanford Container Directory" lists containers commonly used for shipping radioactive materials offsite. Additional guidance on container selection may be obtained from Traffic.

Containers selected must be either DOT specification containers loaded as specified in 49 CFR 173.400-.478 (unless exempted) or containers approved by NRC or DOE on which there is a current COC, and for which DOE-RL or WHC has been registered as a user. When NRC- or DOE-approved containers are used, a thorough review of the current COC and the associated SARP must be made to identify authorized contents, unusual packaging requirements, limitations, and/or administrative controls.

These requirements must be incorporated into appropriate internal procedures prior to initial use of the container. The above documentation must be maintained by the shipper for at least one year after last usage.

2. Obtain the container and inspect it. Work procedures, COCs, and SARPs list inspection requirements, as appropriate, and may require quality assurance/quality control verification.
3. Load the container with authorized contents only. Assemble and seal the package in accordance with appropriate procedures.
4. Arrange for a radiation survey of the package(s) to determine that smearable contamination limits (49 CFR 173.443) and radiation dose rate limits (49 CFR 173.441) are not exceeded.
5. Assure that if heat producing radionuclides are being shipped the thermal limits of 49 CFR 173.442 are met.
6. Determine the fissile class for each package based on an appropriate criticality analysis if packages contain greater than exempted quantities of fissile material (49 CFR 173.453).
7. Determine the Transport Index for each package as appropriate (49 CFR 173.403(bb)).
8. Mark and label each package as required by 49 CFR 172 Subpart D and 49 CFR 172 Subpart E, respectively. See Tables IV-3-3 and IV-3-4 for summary requirements.

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9. Determine category and security requirements if SNM. (See DOE Order 5632.4 and WHC-CM-4-33, "Security Manual".)
10. Schedule shipment in advance with Traffic, Transportation, and Safeguards and Security, where appropriate.
11. Complete an ORSR per instructions found in Part IV, Section 3.3 that follow. Send the completed ORSR, together with other pertinent papers or instructions, with the shipment to the WHC shipping facility, 1167 Building, 1100 Area.
12. Furnish appropriate placards to the carrier (see 49 CFR Part 172 Subpart F) or, if vehicle is equipped with permanent placards, assure that placards are turned to the proper hazards.
13. Assure that riggers or truck drivers are aware of any tiedown requirements named in the associated COCs, SARPs, work procedures, etc. It is the packager/shipper's responsibility to inspect and approve securing of all loads to assure tiedown requirements are met.

3.3 PREPARING OFFSITE RADIOACTIVE SHIPMENT RECORDS (ORSR)

The following instructions are keyed to number blocks on a specimen copy of the ORSR (Exhibit IV-3-1).

3.3.1 Shipment Instructions Section Completed By Originator

1. Provide a complete shipping address. (NOTE: Post office box numbers are not acceptable as an address unless routing is by parcel post.) The shipment is to be directed to the attention of an individual whose name must appear after the complete address. Check the DOE Directory of Reporting Identification Symbols (RIS book) to assure proper address for receipt of materials (usually different from mailing address).
2. Check the box identifying the originating contractor.
3. Indicate if the shipment is prepaid or collect. Recommend the mode of transport.
4. Print site carrier's name, payroll number and vehicle number.

3.3.2 Shipment Description Section Completed By Originator/Shipper

1. Check appropriate box to indicate proper shipping name and UN identification number for each package (e.g., Radioactive Material, Fissile n.o.s., UN 2918).

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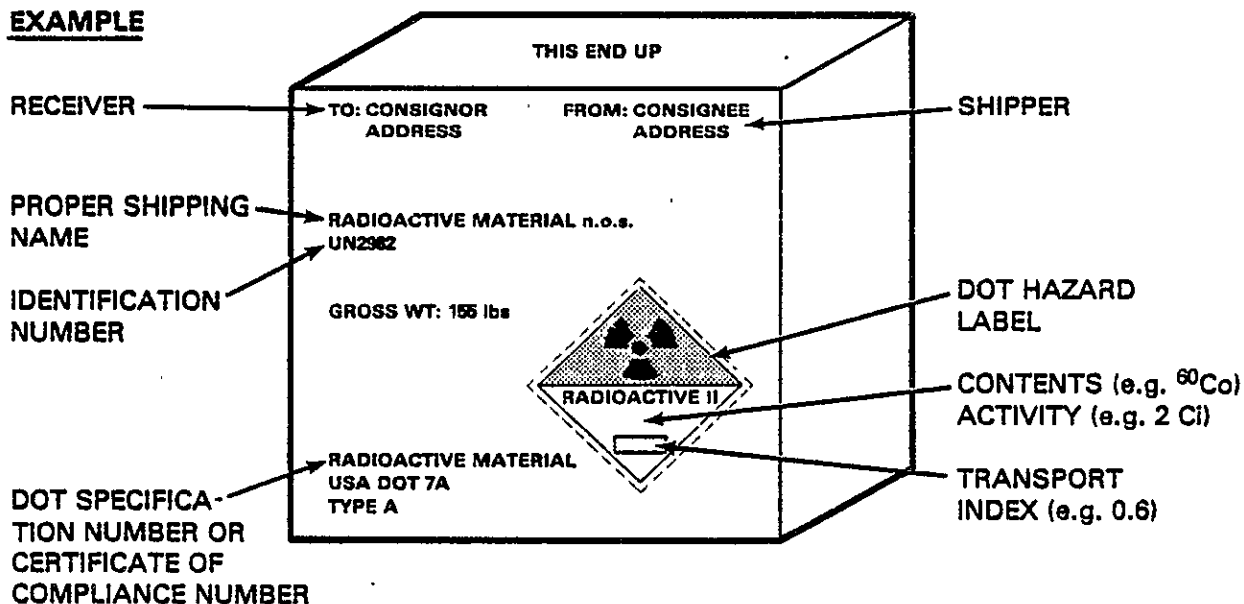
## MARKING REQUIREMENT SUMMARY\*

### PACKAGE MARKING CHECKLIST

- PROPER SHIPPING NAME (e.g. RADIOACTIVE MATERIAL n.o.s.)
- IDENTIFICATION NUMBER (e.g. UN2982)
- CONSIGNEE'S/CONSIGNOR'S NAME AND ADDRESS
- GROSS WEIGHT (IF >110 lbs (50 kg))
- TYPE A OR TYPE B AS APPROPRIATE
- USA (IF FOR EXPORT)
- DOT SPECIFICATION NUMBER OR CERTIFICATE OF COMPLIANCE NUMBER
- THIS SIDE UP/THIS END UP (WHEN INSIDE PACKAGE CONTAINS LIQUID HM)

\*FOR DETAILS SEE 49CFR172 SUBPART D

### EXAMPLE



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Table IV-3-3. Marking Requirement Summary.

**LABELING REQUIREMENT SUMMARY\***

**1. NO RADIOACTIVE LABELS REQUIRED ON PACKAGES CONTAINING:**

- LIMITED QUANTITY RAM, INSTRUMENTS AND ARTICLES
- LSA MATERIAL BEING SHIPPED EXCLUSIVE USE

**2. EMPTY LABELS GO ON EMPTY RAM SHIPPING CONTAINERS**



**3. LABEL PACKAGE FOR EACH HAZARD CLASS CONTAINED (e.g. RADIOACTIVE, CORROSIVE)**



**4. USE DOT APPROVED LABELS ONLY.**

**5. SELECT PROPER RADIOACTIVE LABEL USING THE FOLLOWING CRITERIA:**



**RADIOACTIVE WHITE I**

**WHITE I**

1.  $\leq 0.5$  mrem/hr AT SURFACE OF PACKAGE
2. NOT FISSILE CLASS II OR III
3. NOT HIGHWAY ROUTE CONTROLLED QUANTITY



**RADIOACTIVE YELLOW II**

**YELLOW II**

1.  $>0.5$  mrem/hr SURFACE OF PACKAGE
2.  $\leq 50$  mrem/hr SURFACE OF PACKAGE
3.  $\leq 1.0$  mrem/hr AT 1 METER
4. NOT FISSILE CLASS III
5. NOT HIGHWAY ROUTE CONTROLLED QUANTITY
6. FOR FISSILE CLASS II,  $T.I \leq 1.0$



**RADIOACTIVE YELLOW III**

**YELLOW III**

1.  $>50$  mrem/hr SURFACE OF PACKAGE
2.  $>1.0$  mrem/hr AT 1 METER
3. FOR FISSILE CLASS II,  $T.I > 1.0$
4. FISSILE CLASS III
5. HIGHWAY ROUTE CONTROLLED QUANTITY

**6. PROPER DATA MUST BE ENTERED ON EACH LABEL (e.g. CONTENTS -  $238\text{Pu}$ ; ACTIVITY - 2 Ci; T.I.3)**

**7. LABELS MUST BE PLACED ON OPPOSITE SIDES OF THE PACKAGE IN UNOBSURED POSITIONS.**

**8. APPLY SPECIAL NOTIFICATION LABELS AS APPROPRIATE (e.g. CARGO-AIRCRAFT ONLY; DANGEROUS WHEN WET, ETC.)**

\*FOR LABELING DETAILS SEE 49CFR172 SUBPART E

Table IV-3-4. Labeling Requirement Summary.

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SHIPPING INST.	SHIP TO: <b>3.3.1 SHIPPING INSPECTION SECTION</b>		OFFSITE RADIOACTIVE SHIPMENT RECORD - EXTERIOR INSPECTION PERMITTED -	
	Company _____		Contractor: <input type="checkbox"/> PNL <input type="checkbox"/> KEH <input type="checkbox"/> WHC	
SHIPPING INST.	Address _____		Site Carrier _____	
	City, State, Zip _____		PR No. _____ Veh. No. _____	
SHIPPING INST.	Attention: _____		Ship: <input type="checkbox"/> Prepared <input type="checkbox"/> Collect Via: _____	
			<input type="checkbox"/> Motor-Rail <input type="checkbox"/> Air Psgr <input type="checkbox"/> Excl. Use <input type="checkbox"/> Air Cargo <input type="checkbox"/> DOE Veh. <input type="checkbox"/> Mail <input type="checkbox"/> UPS Sur. <input type="checkbox"/> _____	
SHIPPING INST.	Proper Shipping Name _____ UN Number _____		Material Form: <input type="checkbox"/> Special (A1) <input type="checkbox"/> Normal (A2)	
	Radioactive Material, _____		Labels Applied: <input type="checkbox"/> Empty <input type="checkbox"/> Radioactive LSA <input type="checkbox"/> White I <input type="checkbox"/> Yellow II <input type="checkbox"/> Yellow III <input type="checkbox"/> None <input type="checkbox"/> Danger (Air Cargo) <input type="checkbox"/> Secondary	
SHIPPING INST.	1. Empty Packages <input type="checkbox"/> UN 2908 2. Low Specific Activity, n.o.s. <input type="checkbox"/> UN 2912 3. Limited quantity, n.o.s. <input type="checkbox"/> UN 2910 4. N.O.S. <input type="checkbox"/> UN 2982 5. Fissile n.o.s. <input type="checkbox"/> UN 2918 6. Special Form, n.o.s. <input type="checkbox"/> UN 2974 7. Instruments & Articles <input type="checkbox"/> UN 2911 8. _____ <input type="checkbox"/> _____		Material Category: <input type="checkbox"/> Empty <input type="checkbox"/> Low Specific Act. (LSA) <input type="checkbox"/> Limited Quantity <input type="checkbox"/> Type A Quantity <input type="checkbox"/> Type B Quantity <input type="checkbox"/> Highway Route <input type="checkbox"/> Controlled Quantity	
			For Normal Form Identify: Physical Form <input type="checkbox"/> Solid <input type="checkbox"/> Liquid <input type="checkbox"/> Gas Chemical Form <input type="checkbox"/> Metal <input type="checkbox"/> Oxide <input type="checkbox"/> Elemental <input type="checkbox"/> Nitrate Other _____	
SHIPPING INST.	TYPE PACKAGE <input type="checkbox"/> Strong Tight <input type="checkbox"/> Type A <input type="checkbox"/> Type B <input type="checkbox"/> Type B (U) <input type="checkbox"/> Type B (M)		CONSTRUCTION <input type="checkbox"/> Box, FB <input type="checkbox"/> Wood <input type="checkbox"/> Steel <input type="checkbox"/> Drum <input type="checkbox"/> Cask <input type="checkbox"/> Other _____	
	FISILE CLASS <input type="checkbox"/> Non Fissile <input type="checkbox"/> Fissile Exempt <input type="checkbox"/> Fissile I <input type="checkbox"/> Fissile II <input type="checkbox"/> Fissile III <input type="checkbox"/> Grams Fissile _____		SNM <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> <1 gr <input type="checkbox"/> Category I <input type="checkbox"/> Category II <input type="checkbox"/> Category III	
SHIPPING INST.	ACCOUNTABILITY/SECURITY CONTROL <input type="checkbox"/> Classified <input type="checkbox"/> Unclassified		Consignee authorized to receive this qty <input type="checkbox"/> Sig. Security Svc. Reg. <input type="checkbox"/> NA <input type="checkbox"/> Pu, EU > 1 g <input type="checkbox"/> NU, OU > 1 Kg <input type="checkbox"/> Security Escorts Req. <input type="checkbox"/> Not. Req. <input type="checkbox"/>	
	External Cask Temperature (Max. 122°F LTL, 180°F Ex. Use) _____		_____	
SHIPPING INST.	Packing conforms to appropriate packaging procedure <input type="checkbox"/> N/A <input type="checkbox"/> Yes		Container examined: No evidence of deterioration or damage <input type="checkbox"/> Yes	
	Complies with D. O. T. packaging marking and labeling requirements <input type="checkbox"/> N/A <input type="checkbox"/> Yes		QA Inspection Current <input type="checkbox"/> Yes <input type="checkbox"/> N/A <input type="checkbox"/> No	
SHIPPING INST.	Container acceptability documented (incl. 7A cert.) <input type="checkbox"/> N/A <input type="checkbox"/> Yes		Shipping Doc. _____ Authorization No. _____	
	No. Pkgs. _____ Model Package _____ COC/Spec. No. _____ Serial No. _____ Seal No. _____		Isotopes _____ Curies/Pkg _____ T.I. _____ Gr. Wt. _____	
SHIPPING INST.	TOTAL _____		TOTAL _____	
	Originator's Signature _____ Date _____ Organization _____		Complete Cost Code (inc. end function) _____	
SHIPPING INST.	Surface Dose Rate of Package <input type="checkbox"/> ≤ 0.5 or _____ mrem/hr (N + Bγ) <input type="checkbox"/> ≤ 0.5 or _____ mrem/hr (N + Bγ)		Smears of Outer Container <input type="checkbox"/> ≤ 22 dpm Bγ/cm <sup>2</sup> <input type="checkbox"/> ≤ 2.2 dpm α/cm <sup>2</sup>	
	Additional Data and Instructions (inc. Readings on Internal Packaging) _____		TRUCK LOAD OR EXCLUSIVE USE <input type="checkbox"/> Surface: <input type="checkbox"/> ≤ 200 mrem/hr (N + Bγ) <input type="checkbox"/> @ 6 feet: <input type="checkbox"/> ≤ 10 mrem/hr (N + Bγ) <input type="checkbox"/> @ Cab <input type="checkbox"/> ≤ 20 mrem/hr (N + Bγ) or Sleeper	
SHIPPING INST.	<b>3.3.3 AREA RADIATION MONITORING SECTION</b>			
	Signature - Radiation Monitoring _____ Bldg. _____ Survey No. _____ Date _____			
SHIPPING INST.	<b>3.3.4 AUTHORIZATION FOR SHIPMENT AND CERTIFICATION SECTION</b>			
	AIR TRANSPORT CERTIFICATION > Cargo Only: <input type="checkbox"/> Danger Labels Applied <input type="checkbox"/> Passenger: <input type="checkbox"/> 1. Ltd. Qty. <input type="checkbox"/> 3. Research or Medical Diagnosis <input type="checkbox"/> Pkg. Dimensions <input type="checkbox"/> 2. ≤ 3 T.I. <input type="checkbox"/> 4. Human Medical Research			
SHIPPING INST.	This is to certify that the above named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation, according to the applicable federal, state, local and international regulations for the transportation of hazardous materials.			
	Authorized Signature _____ Printed Name _____ Date _____			
SHIPPING INST.	<b>3.3.5 APPROVED FOR OFFSITE SHIPMENT SECTION</b>			
	B. L. No. _____ Date Shipped _____ E. T. A. _____ Routing _____ <input type="checkbox"/> N/A <input type="checkbox"/> Placards <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Route Plan <input type="checkbox"/> Yes <input type="checkbox"/> No			
SHIPPING INST.	Surveyed By _____ Date _____ Approved for Shipment _____ Westinghouse Hanford Company _____ Date _____			

54-6000-088 (4/88)

Exhibit IV-3-1. Specimen Copy of an Offsite Radioactive Shipment Record

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2. Identify material form (e.g., special or normal). If normal form, the physical and chemical form of the material must also be identified by checking the appropriate boxes.
3. Identify labels applied to the package(s) including secondary hazard labels (49 CFR 172 Subpart E).
4. Identify quantity category (e.g., limited quantity, Type A, Type B, HRCQ).
5. Identify type of package (e.g., strong tight, Type A, Type B) and identify the type of construction (e.g., wood or steel box).
6. Make fissile declaration by checking appropriate box. If fissile, check class and indicate total grams of fissile material.
7. Indicate if SNM is present by checking appropriate boxes. (See DOE Order 5632.4.)
8. Indicate if shipment is classified or unclassified and if consignee is authorized to receive this material. Check if signature security service is required, indicate criteria used for this determination. Check if security escorts are required.
9. Indicate external cask temperature if over ambient temperature.
10. Answer self explanatory questions and identify shipping document number and authorization number.
11. Identify each package and its contents by inserting the required data. This information must be detailed and complete.

NOTE: The activity in curies must be converted to becquerels for shipment of radioactive material by air.

12. Sign and date the form and identify the originator's organization and cost code.

3.3.3 Area Radiation Monitoring Section Completed By Radiation Protection Technologist

1. A Radiation Protection Technologist (RPT) surveys each package and records dose rates at the surface and at 1 m. Shipments with multiple containers must show highest readings found. Smears are taken on each package and the data is entered. Packages must not be released for shipment until Federal standards are met (49 CFR 173.443 and 173.441).
2. When truckload or exclusive-use shipments are made, the transport equipment is surveyed and required data recorded. Show actual readings.

3. The RPT signs and dates the form and records the survey number.

3.3.4 Authorization for Shipment and Certification Section Completed by Certifier

1. If shipment is to be by air, indicate if shipment is authorized for passenger aircraft and under which criteria it qualifies (e.g., limited quantity, T.I.  $\leq 3.0$ , etc.). If not authorized for passenger aircraft, indicate the "Danger, Cargo Aircraft Only" labels have been applied.
2. If shipment is to be by air, the package dimensions must also be provided.
3. The authorized signature in this section certifies that materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation all in compliance with the DOT regulations. The authorizing signature must be one of a delegated employee who has passed the Certification of Hazardous Material Shipments course. Retraining in this course is required every 2 years to retain signature authorization.

3.3.5 Approved for Offsite Shipment Section Completed By Traffic

1. Traffic records the bill of lading number, the date shipped, the ETA, and routing information.
2. The 1100 Area RPT signs and dates the form, indicating concurrence of area radiation monitoring data.
3. Traffic indicates whether placards or route plans are required by checking appropriate boxes.
4. Traffic signs and dates the form indicating final shipment approval.

3.4 **RADIOACTIVE MATERIAL TRANSPORTED BY THE TRANSPORTATION SAFEGUARDS DIVISION, U.S. DEPARTMENT OF ENERGY, ALBUQUERQUE OPERATIONS OFFICE**

These operating instructions establish specific practices for the shipping and receiving of radioactive shipments transported by Transportation Safeguards Division (TSD) of DOE-ALO.

3.4.1 Responsibilities

The Manager, DOE-ALO, manages the Transportation Safeguards System for domestic shipments of nuclear explosives, Category I quantities of SNM (excluding Naval reactor core shipments), classified configurations of Category II quantities of material when requested by responsible outlying program managers, and any form of  $^{238}\text{Pu}$  in excess of 5 g. This responsibility is executed by the Director of the TSD.

The DOE-RL delegated Westinghouse the Operational Contact responsibility for SST transport between the TSD and Hanford Site contractors. The Operational Contact shall exercise total control of all TSD movement at the Hanford Site and shall keep DOE-RL Safeguards Branch informed of all activity.

The following individuals function as Operation Contacts:

- o D. V. Kelley, 373-2541
- o J. Washburn, 373-2393
- o C. D. Hansen, 376-7494

Duties of the Operational Contact include the following:

1. Coordinate all SST shipments at the Hanford Site. This includes preparation, classification, and submission of shipment requests and other communications concerning individual movements directly to TSD via secure communications with a copy to DOE-RL.
2. Maintain appropriate records of correspondence relating to TSD services.
3. Submit an annual forecast of Hanford Site SST requirements to DOE-RL.
4. Compare the annual forecast to actual and planned use of TSD services on a quarterly basis for RL information, and as a tool to evaluate the need to update the annual forecast.
5. Provide assistance to TSD couriers.
6. Provide services defined by the TSD Operating Principles Document or those dictated by TSD.

#### 3.4.2 General Procedures

The following general procedures shall be observed.

1. Information concerning movement of TSD vehicles is classified "Confidential-National Security Information" and shall be provided only to authorized recipients on a need-to-know basis. Personnel administering the SST at Hanford must possess a Level 2 or 3 clearance and those receipting for material, custody of vehicles and equipment or shipping material on a courier receipt must be authorized to do so by TSD upon the recommendation of DOE-RL. The movement of materials associated with defense weapons programs is classified "Secret-Restricted Data" and must be documented and handled accordingly.

2. Personnel who execute Radioactive Shipment Records (Onsite (RSRs) or Offsite (ORSRs)) for the movement of the SST while on the Hanford Site must hold the proper delegation of authority. Signature cards for such personnel must be on file with the Contractor Security Offices.
3. Shipments in the SST are exempt from "sabotage device/unauthorized personnel" searches before loading that are prescribed in DOE Order 5632.4.

### 3.4.3 Specific Receiving Procedures

The following specific receiving procedures shall be observed.

1. Formal notification of all inbound shipments will be sent to the Operational Contact before the delivery date. This notification will be received via classified message when the shipper requests TSD service. The TSD will provide the actual schedule of the SST and will provide all pertinent information about the shipment. When the TSD message is received, the Operational Contact will advise the DOE-RL contractor representative of the arrival date and what materials are involved.
2. Movement of SSTs are classified. Care should be taken to prevent the dissemination of schedules and changes by unsecured methods. A classified system established by Security is used to accommodate communications of schedules and changes.
3. The SST may arrive after normal working hours. The SST is authorized to seek safe haven at any government facility and may come and go without local coordination or documentation. Materials moved via the SST must meet specific criteria outlined in DOE Order 5632.4 to be accepted for this method of transportation. Accountability for these materials is transferred through use of Form DOE/NRC 741. Material custody is transferred by special courier receipt, therefore, normal receiving procedures are not appropriate. The shipments are not stopped at the 1100 Area, are not received by a Material Function storekeeper, and are not required to have a radiation survey check at the 1100 Area.
4. The SST will proceed either to the 300 Area for safe haven in the 308 protected area or to the Plutonium Finishing Plant (PFP) protected area, depending on who the consignee is and where the material is to be offloaded or loaded.
5. When the shipment is consigned to PNL or WHC at the 300/400 Area, the contractor field representatives will arrange for radiation survey and personnel for unloading. The WHC riggers move the materials from the SST to a designated place under escort where the authorized custodians accept the material.

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When the shipment is consigned to the 200 Areas, there are two designated points for unloading:

- a. Shipment consigned for waste disposal will be off-loaded and received by burial grounds personnel at the 200 West Disposal Site staging area. The staging area is a materials handling area consisting of a large asphalted pad with a truck loading dock capable of handling three trailers. Trailer-to-trailer and trailer-to-loading dock operations may be completed at the staging area. The burial ground manager on duty will arrange for radiation monitoring, riggers, and burial ground personnel as required based on arrival time of the SST. Close coordination between the SST Operational Contact and the burial ground manager is essential to maintain effective utilization of personnel. The SST shipments to the burial grounds are infrequent, therefore, must be performed in addition to other scheduled work and completed within the shortest possible delay to other activities.
  - b. Shipments consigned to the PFP will be unloaded at the 2736-ZB Shipping and Receiving Facility. Product handling custodians must coordinate their activities to allow scheduling of personnel to monitor, receive, and handle unloading operations.
6. If no authorized contractor recipients are present, the Operational Contact may receive material and arrange for temporary custody and security as circumstances require.
  7. If the SST does not have a return load, the custodian of the delivered material will execute Form AL-75, "Shipment Certification" certifying that radiation dose rate levels and removable contamination are within the limits prescribed in 49 CFR 173.443. A radiation survey must support this certification, 49 CFR 173.441.

#### 3.4.4 Specific Shipping Procedures

The following specific shipping procedures must be observed.

1. The TSD preplans each of its trips based on the shipper's request for services and issues a plan to the convoy leader on or before departure from the point of origin. The preplan may provide for transloading and for storage enroute to destination. Changes are not permitted without the approval of the TSD. Changes in type and quantity of material, number, type and size of container, and destination should be scheduled two weeks in advance of loading to ensure acceptance by TSD.
2. The packager will perform the following duties:
  - a. Prepare the material transfer documents and unclassified "gate pass"-type of ORSRs before SST loading.



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- b. Witness and approve the loading configuration and the tiedowns.
  - c. Ensure that radiation survey data for packages and vehicle is entered on the ORSR, and that Form AL-75 "Shipment Certification" is executed after the shipment has been released by the Operational Contact and made a part of the shipping papers.
  - d. Approve release of shipment to the convoy commander, and distribute copies of the ORSR.
  - e. Use a special receipt provided by the DOE courier to document and transfer custody to the TSD. The TSD two-man rule requires two couriers to sign every receipt for SNM. Custody transfer receipts are maintained in the shipment case file.
3. Traffic will perform the following regulatory compliance duties:
- a. Assign a shipment number to the ORSR.
  - b. Inspect the exterior of each package to verify that the package is in good order and properly marked, labeled, closed, and sealed.
  - c. Verify that the packaging meets the applicable regulations for shipment via the SST and that package data is accurately entered on the transfer documents and ORSR.
  - d. Sign the ORSR in the "Approval for Shipment" block.
4. Procedures for requesting transportation services by the TSD via SST are found in DOE-ALO Order AL-56XA, "DOE Transportation Safeguards System", and repeated here for user convenience.
- a. The nuclear materials control officers for DOE-RL contractors must submit a TSD Standard 19-point request for SST services to the Operational Contact through the appropriate classified document control channels.
  - b. The request must reach the TSD Planning Branch, Albuquerque, New Mexico at least 14 days before the requested date of movement. Emergency requests may be submitted at any time and the Planning Branch will try to accommodate the request.
  - c. All requests are classified. Defense weapons material must be classified "Secret, Restricted Data," and with few exceptions, the movement of non-weapons material will be classified "Confidential, National Security Information."

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5. The TSD Standard 19 point request to be completed for services follows:

ITEMINFORMATION REQUIRED

1. Material type (AEC Appendix 74010C, Part 13.F, page 7)
2. Available date and time (do not indicate "as soon as possible").
3. Level of classification and type of information (when appropriate).
4. Transport index per container.
5. High explosive content. Enter net weight and class of explosives in the shipment. Enter the word "none" if appropriate.
6. Consignor (RIS Symbol) and pickup point (location/area/building).
7. Number of containers.
8. Shipment I.D. This shall be the unique identifier formulated by the consignor or his DOE organization as needed for computerized recordkeeping.
9. Gross weight per container.
10. Consignee (RIS Symbol) and delivery point (location/area/building).
11. Item common name (when one exists).
12. Composition code (AEC Appendix 7401-C, Part II 13.G., page 7).
13. Deadline delivery date and time (do not indicate "as soon as possible").
14. Justification for TSD courier safeguarding. Designate the appropriate category by paragraph number (i.e., 1.c., 2.b.) as specified in Chapter IV of this order.
15. Material gram weight per container.
16. Type container to be used and dimension. Dimensions not required when this data is available in the publications: "Directory of Packagings for Transportation of Radioactive Materials" (WASH 1279) and "Directory of DOE Certificates of Compliance for Radioactive Material Packaging" however, dimensions must be provided when more than one container external size is shown in WASH 1279 under one DOT identification or when shown in the TSD maintained document, "Component/Product Hazardous Material Record."

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17. Special handling requirements (when temperature control is required, specify acceptable range).
18. Budget activity program code.
19. DOE/NRC Form 741 transfer series data is recorded in Block 3 of form when nuclear materials are to be shipped. This can be provided orally subsequent to initial input.

The planning branch, TSD, will review the request for transportation services and schedule movement of the material as close to the requested dates as the availability of personnel and equipment will allow.

### 3.4.5 Shipping Papers

Public Law 86-710 and 49 CFR 173.7(b) exempts DOE-couriered shipments in the SST from commercial shipping paper requirements that describe the hazardous material being transported. For internal control purposes however, DOE issues a Courier Receipt that, together with Nuclear Material Transfer Documents, serve as shipping papers, all of which are classified. An unclassified "gate pass"-type document will record the radiation survey to allow the SST to exit from protected areas. A standard ORSR form will serve that purpose when properly executed.

The following instructions are keyed to numbered blocks on a specimen copy of the ORSR (Exhibit IV-3-2). These forms shall be prepared for each shipment offered for movement.

1. The Shipment Instruction Section is to be completed by the Originator.
  - a. Enter the words "See file (#\_\_\_\_\_) and assign a file number.
  - b. Check box for originating contractor.
  - c. Check box for DOE vehicle.
2. The Shipment Description Section is completed by the Originator.
  - a. Check box for Radioactive material, n.o.s, UN 2982.
  - b. Identify labels on containers.
  - c. Identify quantity category (e.g., Type A, Type B, etc.).
  - d. Check normal form or special form as appropriate. Disregard physical and chemical form questions.

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**SHIPMENT INSTRUCTION SECTION**

<b>SHIPMENT INSTRUCTIONS</b>	<b>SHIP TO:</b> Company: <u>1.a</u> Address: <u>SEE FILE (# )</u> City, State, Zip: _____ Attention: _____		<b>OFFSITE RADIOACTIVE SHIPMENT RECORD</b> - EXTERIOR INSPECTION PERMITTED -																																																																																											
			Contractor: <input type="checkbox"/> PNL <input type="checkbox"/> KEH <input type="checkbox"/> WHC <u>1.b</u> Site Carrier: _____ PR No: _____ Veh. No: _____ Ship: <input type="checkbox"/> Prepaid <input type="checkbox"/> Collect <input type="checkbox"/> Via: _____ <u>1.c</u> <input type="checkbox"/> Motor-Rail <input type="checkbox"/> Air Psgr. <input type="checkbox"/> Excl. Use <input type="checkbox"/> Air Cargo <input type="checkbox"/> DOE Veh. <input type="checkbox"/> Mail <input type="checkbox"/> UPS Sur.																																																																																											
<b>SHIPMENT DESCRIPTION</b>	<b>Proper Shipping Name</b> Radioactive Material: 1. Empty Packages <input type="checkbox"/> UN 2908 2. Low Specific Activity, n.o.s. <input type="checkbox"/> UN 2912 3. Limited quantity, n.o.s. <input type="checkbox"/> UN 2910 4. N.O.S. <u>2.a</u> <input checked="" type="checkbox"/> UN 2982 5. Fissile n.o.s. <input type="checkbox"/> UN 2918 6. Special Form, n.o.s. <input type="checkbox"/> UN 2974 7. Instruments & Articles <input type="checkbox"/> UN 2911 8. _____		<b>UN Number</b> Material Form: <input type="checkbox"/> Special (A1) <u>2.d</u> <input type="checkbox"/> Normal (A2)		<b>For Normal Form Identify:</b> Physical Form <input type="checkbox"/> Solid <input type="checkbox"/> Liquid <input type="checkbox"/> Gas Chemical Form <input type="checkbox"/> Metal <input type="checkbox"/> Oxide <input type="checkbox"/> Elemental <input type="checkbox"/> Nitrate Other: _____																																																																																									
	<b>Labels Applied</b> <input type="checkbox"/> Empty <input type="checkbox"/> Radioactive LSA <u>2.b</u> <input type="checkbox"/> White I <input type="checkbox"/> Yellow II <input type="checkbox"/> Yellow III <input type="checkbox"/> None <input type="checkbox"/> Danger (Air Cargo) <input type="checkbox"/> Secondary		<b>Material Category</b> <u>2.c</u> <input type="checkbox"/> Empty <input type="checkbox"/> Low Specific Act. (LSA) <input type="checkbox"/> Limited Quantity <input type="checkbox"/> Type A Quantity <input type="checkbox"/> Type B Quantity <input type="checkbox"/> Highway Route <input type="checkbox"/> Controlled Quantity																																																																																											
	<b>TYPE PACKAGE</b> <input type="checkbox"/> Strong Tight <input type="checkbox"/> Type A <input type="checkbox"/> Type B <input type="checkbox"/> Type B (U) <input type="checkbox"/> Type B (M) <u>2.e</u>	<b>CONSTRUCTION</b> <input type="checkbox"/> Box, FB <input type="checkbox"/> Wood <input type="checkbox"/> Steel <input type="checkbox"/> Drum <input type="checkbox"/> Cask <input type="checkbox"/> Other _____	<b>FISILE CLASS</b> <input type="checkbox"/> Non Fissile <input type="checkbox"/> Fissile Except <u>2.f</u> <input type="checkbox"/> Fissile I <input type="checkbox"/> Fissile II <input type="checkbox"/> Fissile III <input type="checkbox"/> Grams Fissile	<b>SNM</b> <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> < 1 gr <input type="checkbox"/> Category I <input type="checkbox"/> Category II <input type="checkbox"/> Category III	<b>ACCOUNTABILITY/SECURITY CONTROL</b> <input type="checkbox"/> Classified <input type="checkbox"/> Unclassified Consignee authorized to receive this qty <input type="checkbox"/> Sig. Security Svc. Reg. <input type="checkbox"/> <u>2.g</u> NA <input type="checkbox"/> Pu. EU > 1 g <input type="checkbox"/> N/A <input type="checkbox"/> 1 Kg <input type="checkbox"/> Security Escorts Req. <input type="checkbox"/> Not. Req. <input type="checkbox"/> External Cask Temperature <u>2.h</u> N/A <input type="checkbox"/> (Max. 122° F LTL, 180° F Ex. Use) °F																																																																																									
	Packaging conforms to appropriate packaging procedure <input type="checkbox"/> N/A <input type="checkbox"/> Yes Complies with D O T packaging marking and labeling requirements <input type="checkbox"/> N/A <input type="checkbox"/> Yes Container acceptability documented (incl. 7A cert.) <input type="checkbox"/> N/A <input type="checkbox"/> Yes Container examined: No evidence of deterioration or damage <input type="checkbox"/> Yes QA Inspection Current <input type="checkbox"/> Yes <input type="checkbox"/> N/A <input type="checkbox"/> No <input type="checkbox"/> Yes Shipping Doc. _____ Authorization No _____																																																																																													
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>No Pkgs</th> <th>Model Package</th> <th>COC Spec No</th> <th>Serial No.</th> <th>Seal No</th> <th>Isotopes</th> <th>Curies/Pkg</th> <th>T.I.</th> <th>Gr Wt</th> </tr> </thead> <tbody> <tr> <td colspan="9" style="text-align: center;"><u>2.i</u> SEE ATTACHED LISTING</td> </tr> <tr> <td colspan="9" style="text-align: center;"><b>SHIPMENT DESCRIPTION SECTION</b></td> </tr> <tr> <td colspan="9" style="height: 40px;"></td> </tr> <tr> <td colspan="9" style="height: 40px;"></td> </tr> <tr> <td colspan="9" style="height: 40px;"></td> </tr> <tr> <td colspan="9" style="height: 40px;"></td> </tr> <tr> <td colspan="9" style="height: 40px;"></td> </tr> <tr> <td colspan="9" style="height: 40px;"></td> </tr> <tr> <td colspan="9" style="text-align: right;">TOTAL</td> </tr> </tbody> </table>					No Pkgs	Model Package	COC Spec No	Serial No.	Seal No	Isotopes	Curies/Pkg	T.I.	Gr Wt	<u>2.i</u> SEE ATTACHED LISTING									<b>SHIPMENT DESCRIPTION SECTION</b>																																																															TOTAL								
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(Packer may describe package in detail on one of unused lines above) Originator's Signature: _____ Date: _____ Organization: _____ Complete Cost Code (inc. end function): _____																																																																																														
<b>AREA MONITOR</b>	<b>Surface Dose Rate of Package</b> <u>3.a</u> <input type="checkbox"/> ≤ 0.5 or _____ mrem/hr (N + Bγ) <input type="checkbox"/> ≤ 0.5 or _____ mrem/hr (N + Bγ)		<b>Dose Rate at 1 Meter from Surface of Package</b> <input type="checkbox"/> ≤ 22 dpm Bγ/cm <sup>2</sup> <input type="checkbox"/> ≤ 2.2 dpm α/cm <sup>2</sup>		<b>TRUCK LOAD OR EXCLUSIVE USE</b> Surface: <input type="checkbox"/> ≤ 200 mrem/hr (N + Bγ) @ 6 feet: <input type="checkbox"/> ≤ 10 mrem/hr (N + Bγ) @ Cab <input type="checkbox"/> ≤ 2.0 mrem/hr (N + Bγ) or Sleeper																																																																																									
	<b>Additional Data and Instructions (inc. Readings on Internal Packaging)</b> <b>AREA RADIATION MONITORING SECTION</b> Signature - Radiation Monitoring <u>3.b</u> Bldg. _____ Survey No _____ Date _____																																																																																													

**AUTHORIZATION FOR SHIPMENT AND CERTIFICATION SECTION**

<b>CERTIFIER</b>	<b>AIR TRANSPORT CERTIFICATION</b> <u>4.a</u> Cargo Only: <input type="checkbox"/> Danger <input type="checkbox"/> Labels Applied		Passenger: <input type="checkbox"/> 1. Ltd. Qty. <input type="checkbox"/> 3. Research or Medical Diagnosis <input type="checkbox"/> 2. ≤ 3 T.I. <input type="checkbox"/> 4. Human Medical Research		Pkg. Dimensions
	This is to certify that the above named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation, according to the applicable federal, state, local and international regulations for the transportation of hazardous materials.				
	Authorized Signature <u>4.b</u>	Printed Name _____	Date _____		

**APPROVED FOR OFFSITE SHIPMENT SECTION**

<b>TRAFFIC</b>	B. L. No. _____		Date Shipped _____		E. T. A. _____		Routing _____ <input type="checkbox"/> N/A		Placards <input type="checkbox"/> Yes <input type="checkbox"/> No	
	Surveyed By _____		Date _____		Approved for Shipment Westinghouse Hanford Company <u>5</u>		Date _____		Route Plan <input type="checkbox"/> Yes <input type="checkbox"/> No	

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Exhibit IV-3-2. Specimen Copy of an Offsite Radioactive Shipment Record for Safe, Secure Trailer Shipments.

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- e. Identify package types (e.g., strong tight, Type A, Type B, etc.). Indicate type of container construction (e.g., wood, steel).
  - f. Disregard fissile class and SNM questions.
  - g. Identify security requirements.
  - h. Indicate external cask temperature, if above ambient.
  - i. Answer questions as appropriate. Provide shipping document number and authorization number.
  - j. Enter words "see attached listing."
  - k. The manager of the group packaging the material or the manager's delegate signs and dates form and enters complete cost code information.
3. The Area Radiation Monitoring Section is completed by the Radiation Protection Technologist (RPT).
    - a. The RPT surveys each package and records dose rates at the surface and at 1 m. Shipment with multiple containers must show highest readings found. Smears are taken on each package and this data is entered. Packages must not be released for shipment until Federal standards are met (49 CFR 173.443 and 173.441).
    - b. The RPT signs and dates the form and records the survey number.
  4. The Authorization for Shipment and Certification Section is completed by the Certifier.
    - a. Disregard air certification questions.
    - b. The authorized signature in this section certifies that materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation. The authorized signature must be one of a delegated individual that appears on a list of approved signatures maintained by Traffic for employees who have passed the "Certification of Hazardous Material Shipments" course.
  5. The Approval for Offsite Shipment Section is completed by Traffic.

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WESTINGHOUSE HANFORD COMPANY

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Procurement and  
Materials Management

TITLE:

SHIPPING AND RECEIVING HAZARDOUS  
MATERIAL IN THE 1100 AREA

Approved by

  
D. K. Quigley, Manager,  
Procurement and Materials Mgmt

## 1.0 PROCUREMENT AND MATERIALS MANAGEMENT AS SHIPPER/RECEIVER FOR DOE-RL

The WHC Procurement and Materials Management function (PMM) is responsible for checking and verifying material shipments before they leave the Hanford Site to assure compliance to Federal regulations. This function is also designated "shipping agent" for other Hanford Site Contractors, in the offsite shipment of hazardous materials other than radioactive materials.

As the shipper for DOE-RL or agent for other contractors, PMM will perform the following tasks:

1. Receive shipments of hazardous materials or shipments requiring special handling from the packager's site to the 1167 shipping facility at the request of the packager. Only those packages accompanied by the Offsite Radioactive Shipment Record (ORSR), Uniform Hazardous Waste Manifest (UHW), or Hazardous Material Shipment Record (HMSR) form which has been completed, signed, and certified that the package is in proper condition for transportation offsite will be accepted for onsite pickup and delivery to 1167.
2. Verify the radiation survey data recorded on the ORSR are correct, or that the HMSR or UHW has a radiation release.
3. Inspect the exterior of the package visually and verify the package is in apparent good order, the packaging data have been correctly recorded on the ORSR, UHW or HMSR, the delivery address on the address label is appropriate for the mode of transportation selected, and the package is properly closed and sealed.
4. Analyze the data on the ORSR, UHW or HMSR and verify that the material, as packaged for offsite shipment, meets the applicable regulatory requirements for the packaging, marking, and labeling of such material and is, therefore, in proper condition for transportation via the mode selected.
5. Arrange with the packager to correct any nonconforming detail of the shipment. Document minor exceptions internally after resolution. Issue a Variance Report for more serious infractions or persistent minor exceptions citing exceptions to the packager with a copy to DOE-RL Projects Management Division (DOE-RL PMD) after correction has been made.

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6. Select mode of transport to accommodate the type of material to be shipped and, if possible, the desired delivery date.
7. Provide temporary storage in the 1167 Building for other than exclusive-use shipments of hazardous materials awaiting transport inbound or outbound.
8. Prepare shipping papers (e.g., bills of lading, air bills, etc.) in accordance with applicable DOT and DOE directives.
9. Schedule commercial carriers to load, other than exclusive-use shipments of hazardous materials, at the 1167 Building and elevate packages to the carrier's equipment. The carriers will secure the loads for shipment.
10. Schedule commercial carriers to load exclusive-use shipments of hazardous materials and/or Category II quantities of SNM at the packager's site. Traffic will inspect and approve tiedowns.
11. Assure that vehicles are placarded for the appropriate hazards, as required by regulations.
12. Process and ship packages daily if they are received at the PMM shipping facility in the 1100 Area at the times shown in the following schedule:

Schedule for Shipments with Normal Handling

<u>Routing</u>	<u>Due in Shipping</u>
United Parcel	2:00 p.m.
Air Freight	2:00 p.m.
Motor-Freight (less than truckload)	2:00 p.m.

13. Notify the consignee, via teletype, of the shipping date, routing, carrier and estimated time of arrival (ETA). Follow the progress of the shipment enroute, expedite delaying factors, and apprise the consignee and originator of revised ETA, if necessary. Confirm actual delivery date and apprise DOE-RL PMD Management of that date.
14. Notify DOE-RL PMD of the shipment on the day it leaves the Hanford Site and provide DOE-RL PMD with copies of the bill of lading, the ORSR or HMSR, and the teletype to the consignee.

Traffic will return to the originator, copies of the ORSR, UHWM or HMSR, complete with any data added by Traffic, regarding the shipment.

15. Inspect packages for regulatory compliance prior to loading onto the safe secure trailer (SST).



16. Maintain on file, the Bureau of Explosives Pamphlets 6, 6A and 6C, and other guidance for developing blocking and bracing plans used in rail shipments. Also see tiedown guidelines found in Appendix C of this manual.
17. Secure export licenses, book space, and prepare documentation for shipments to be exported from the United States. Input information into the International Nuclear Materials Tracking System at Oak Ridge National Laboratory (ORNL), as appropriate.
18. Maintain on file all Certificates of Compliance (COC) covering containers used by Hanford Site contractors. Verify prior to shipment that a certificate is in force and that the package presented for shipment meets its provisions. Distribute copies to users. Verify that the Hanford Site contractor is using a container registered with the NRC (if container is under a NRC-COC) or DOE before first use.

#### 1.1 EXCEPTIONS TO THE PMM FUNCTION AS SHIPPER/RECEIVER FOR DOE-RL

1. Pacific Northwest Laboratory (PNL) is authorized to arrange for offsite shipment of PNL private materials that are of an experimental nature. The conditions and limitations for this are specified in PNL-MA-81, "Radioactive Material Shipping Manual." All DOE-owned material goes through Traffic.

#### 1.2 SHIPPING, TRAFFIC, AND RECEIVING OPERATIONS

In performance of the PMM shipping and receiving duties for Westinghouse and other Hanford Contractors, Traffic works closely with Material Management to assure an efficient operation. The Material Management responsibilities in performing its part are defined in the Material Distribution Manual, WHC-CM-2-2, and will not be repeated here.

The Material Management and the Traffic groups of the PMM function are responsible for performing the following functions:

##### 1.2.1 Shipping

1. Requests the Radiation Protection Technologist (RPT) to survey the radioactive material package(s) and the delivery vehicle at the 1100 Area shipping facility. The RPT will confirm the radiation and contamination levels of the package(s) and sign the ORSR. For exclusive-use shipments loaded in the outer areas, the exterior of the vehicle is surveyed at the 1100 Area prior to departure offsite.
2. Weighs the package(s) when necessary and records the weight on the ORSR and HMSR, as appropriate.

3. Inspects the package(s) for evidence of damage.
4. Calls the offsite Hazardous Material Specialist (OHMS), Traffic, to inspect the package(s), review, and approve the shipment.
5. Obtains the prior shipping papers from Traffic.
6. Loads the shipment into/onto the carrier's equipment secures the driver's signature on the shipping papers, then furnishes appropriate copies to the driver.
7. Provides locked temporary storage in the 1100 Area for other than exclusive-use shipments of radioactive materials awaiting offsite transfer.

#### 1.2.2 Traffic

1. Determines the mode, routing, ETA, and special handling requirements. Issues special instructions to the carrier to assure safe, secure transport within the framework of various regulations. Special considerations suggested by the contractors will be accommodated, when feasible. If considerations as suggested cannot be accommodated, Traffic will make proper arrangements with the originator and carriers.
2. Prepares the shipping papers for delivery to the carrier in the 1100 Area.
3. Performs shipping functions 1 and 2 above when outbound truckload or exclusive-use shipments of empty containers or radioactive materials stop at the 1166 Building for inspection and survey. Secures the driver's signature on the shipping papers and furnishes him with appropriate copies.
4. Performs the following tasks on the day the shipment leaves the Hanford Site:
  - a. Notifies the consignee, by teletype, of the shipment, name of the carrier, and ETA.
  - b. Notifies DOE-RL PMD of the shipment and provides copies of the bill of lading, ORSR or HMSR, and the teletype to the consignee.
  - c. Sends the originator copies of the ORSR or HMSR complete with data added by Traffic regarding the shipment.
5. Follows the progress of outbound shipments, expedites delaying factors, and verifies the shipment was delivered to the consignee.

Notifies appropriate parties of final delivery date, as well as any deviation from the ETA.

6. Maintains an inbound and outbound log book from which shipment control numbers are assigned. Completes the entries with delivery information after the shipment arrives at its destination.
7. Makes progress checks on incoming shipments when information has been provided by the consignor or consignee.
8. Notifies Receiving and others with a need-to-know when a shipment is enroute to the Hanford Site and its ETA.
9. Develops, coordinates, and administers activities according to this manual.
10. Coordinates and approves offsite shipments of hazardous materials. This involves interpreting Federal regulations, inspecting containers tendered for shipment and their associated shipment documentation (ORSR, UHWM, HMSR), reviewing container authorizations, and scheduling carriers.

#### 1.2.3 Receiving

1. Accepts delivery of all inbound hazardous material shipments (except exclusive-use (full-load) shipments) transported by commercial carriers that are consigned to DOE-RL contractors.
2. Requests a radiation survey in each incoming radioactive material package and carrier vehicle to ensure it is free of significant surface contamination. For exclusive-use shipments, only the exterior of the vehicle is surveyed the 1100 Area shipping/receiving facility.
3. Escorts exclusive-use (full-load) shipments directly to the consignee's dock after the RPT survey at the 1100 Area shipping/receiving facility. Processes receiving papers upon verification of package count and condition.
4. Identifies each inbound shipment with a control number obtained from Traffic.
5. Prepares a receiving report for each inbound shipments and inspects packages for evidence of damage.
6. Provides temporary, locked storage in the 1100 Area for other than exclusive-use shipments, pending onsite delivery.
7. Arranges for temporary clearance of carrier personnel making delivery onsite beyond project barricades.

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8. Ensures that only Level 3 cleared employees are assigned to receiving, transporting, and escorting shipments of SNM. Arranges Patrol escort of SNM as required.
9. Prepares and issues an RSR to forward radioactive material shipments to onsite consignees.
10. Notifies the contractor's source and SNM representative upon receipt of this type of material at the 1167 Building. Notifies the consignee when the shipment is ready for dispatch from the 1100 Area for final onsite delivery.

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COURSE 0059 - CERTIFICATION OF HAZARDOUS MATERIAL SHIPMENTS

COURSE OUTLINE

- I. Introduction
- II. Resource documents used in making hazardous material shipments
- III. Service organizations:
  - Traffic Department
  - Packaging Development
- IV. How to use Title 49 CFR Parts 171, 172, & 173
- V. Requirements of DOE-RL Order 5480.1 Chapter III
- VI. Workshop--preparing Offsite Radioactive Shipment Records (ORSRs)
- VII. Workshop--Preparing Onsite Radioactive Shipment Records (RSRs)
- VIII. Workshop--Preparing Hazardous Material Shipment Records (HMSRs)
- IX. Examination

PRIMARY COURSE OBJECTIVE

Provide training in the Department of Transportation "Hazardous Material Regulations", as required by law, to those who certify the compliance of Hanford hazardous material shipments. The main focus will be on the proper preparation and release of radioactive material shipments. Re-certification will be required every two years.

SECONDARY OBJECTIVES

1. The student will understand the reasoning behind the establishment of the regulations, historical background, scope, etc.
2. The student must recognize the primary resource documents used in making hazardous material shipments. They must know where the regulations exist, the general content of the regulations, and how to use the documents properly.
3. The student must know whom to turn to if assistance is needed in interpreting or applying the regulations. Each Hanford Contractor has service organizations who provide this service. The student must know how to interface with these organizations.

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COURSE OUTLINES AND OBJECTIVES

4. The student must become familiar with the Department of Transportation "Hazardous Material Regulations" found in Title 49 Code of Federal Regulations, Parts 171 thru 173. They must know what kinds of requirements are in the document, how to use the document, and understand their responsibility for compliance.
5. The student must be familiar with the requirements found in DOE-RL Order 5480.1 Chapter III "Safety Requirements for the Packaging of Fissile and other Radioactive Materials" and understand their responsibility for compliance.
6. The student must understand the unique terminology used in the packaging and transportation of radioactive materials (e.g., normal form, special form, Type A, Type B, Highway Route Controlled Quantity, etc.).
7. Given sample data concerning materials to be shipped, the student must be able to follow procedures and apply the regulations to properly classify, describe, package, mark, and label the material for shipment; placard the vehicle; and document the shipment on a shipping record.
8. The student must be familiar with the shipping papers used at Hanford for hazardous material shipments, and if given sample data, properly complete each form in compliance with the federal regulations.

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COURSE 006S - HAZARDOUS WASTE SHIPMENT CERTIFICATION

COURSE OUTLINE

- I. Course Introduction
- II. Non-Radioactive Dangerous Waste Management
  - A. Introduction to applicable regulations
  - B. Waste identification and designation
  - C. Generating facility management
  - D. Waste packaging and shipment
  - E. Exercise
- III. Hazardous Material Release Reporting
  - A. Hazardous material releases
  - B. CERCLA reportable releases
  - C. WDOE reportable releases
  - D. SARA reportable releases
  - E. Exercises
- IV. Other Environmental Reporting
  - A. SARA hazardous materials inventory
  - B. SARA toxic chemical release report
  - C. Waste minimization
  - D. Generating/TSD Facility report
  - E. Exercise
- V. Mixed Waste Management
  - A. Introduction to mixed waste (MW)
  - B. Scope of DOE-RL MW Management Directive

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COURSE OUTLINES AND OBJECTIVES

- C. Action planning for the segregation of MW from HLW, TRU, and LLW
- D. Management of MW consistent with non-radioactive hazardous waste management
- E. Summary

VI. PCB Management

- A. Introduction to PCB's
- B. WHC PCB management
- C. Compliance with 40 CFR 761 requirements
- D. Overview of facility PCB management systems
- E. PCB management system responsibilities
- F. Summary of inspections, records, and reporting

VII. Preparation and Shipment of Hazardous Waste

- A. Introduction to applicable regulations
- B. Instructions for using 49 CFR 171-173 & 178
- C. Sample cases
- D. Summary

VIII. Summary and Preparation for Test

PRIMARY COURSE OBJECTIVE

At the completion of this course, the student will have a working knowledge covering the fundamentals of non-radioactive dangerous waste, mixed waste, and PCB management. Re-certification is required every year.

SECONDARY OBJECTIVES

At the completion of this session, the student will be able to:

1. List the major sets of regulations concerning management of hazardous waste.
2. List the dangerous waste characteristics regulated in Washington State.

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## COURSE OUTLINES AND OBJECTIVES

3. Identify information for, and complete a Disposal Analysis Request form.
4. Define RCRA/WDOE waste numbers assigned in the waste designation process.
5. Identify waste management and accumulation requirements for a generating facility under Washington State law.
6. Assign accumulation dates to hazardous/dangerous waste.
7. Identify requirements for management of unknown waste.
8. Read and interpret the disposal analysis letter instructions for packaging, labeling, marking, and transportation of hazardous/dangerous waste.
9. List packaging requirements for "Lab Packs."
10. Differentiate between the three regulatory classes of empty drums.
11. Complete a Uniform Hazardous Waste Manifest.
12. List the waste acceptance and return criteria at the Non-Radioactive Dangerous Waste storage facility (616 Bldg.).
13. Identify a hazardous material release and list internal remediation and response actions.
14. Identify and differentiate between CERCLA, WDOE, and SARA reportable releases.
15. List SARA hazardous materials inventory reporting requirements and identify reportable items.
16. List SARA toxic chemical release reporting requirements and identify reportable items.
17. List regulatory requirements and recommended methods for waste minimization.
18. List information reported to the State in the annual Generator/TSD facility report.
19. Identify mixed waste management requirements for generating facilities under DOE-RL directive.
20. List mixed waste storage area inspection requirements.

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COURSE OUTLINES AND OBJECTIVES

21. Identify mixed waste management activities.
22. List mixed waste segregation and certification requirements.
23. List PCB container marking and labeling requirements.
24. Identify PCB storage area requirements.
25. List criteria for use of PCB equipment/systems at a facility.
26. Identify information for the completion of a Uniform Hazardous Waste Manifest.
27. Identify marking requirements for a given container of waste.
28. Identify labeling requirements for a given container of waste.
29. Identify information for the completion of a Hazardous Waste sticker.

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COURSE OUTLINES AND OBJECTIVES

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COURSE 060401 - NUCLEAR MATERIAL CUSTODIAN TRAINING

Prerequisite: Nominated by manager, and 3 or 5 Clearance.

This is the formal training required as certification for Safeguards approval as a Nuclear Material Custodian. The course requires an end of course examination completion with 80% accuracy. Annual re-qualification is necessary to maintain continuing certification.

This course is directed to the supervisory or technical personnel who are responsible for activities involving the storing, processing, or transferring of nuclear materials.

The main objectives are to train the custodians in the methods used for the control and accountability of nuclear materials and their requirements and responsibilities for implementing those methods.

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Organization

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Procurement and  
Materials Management

HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

TITLE:

Approved by

SHIPMENT EXAMPLES

D. K. Quigley, Manager,  
Procurement and Materials Mgmt

1.0 HAZARDOUS MATERIAL SHIPMENTS

The following examples illustrate the steps used in preparing a HM shipment. To assist in the examples, a small portion of the 49 CFR 172.101 Hazardous Materials Table is reproduced here in Table APP B-1-1. All column references in the examples are to Table APP B-1-1, where applicable. Each example includes a completed HMSR form (Exhibit APP B-1-1, APP B-1-2) with the specific data.

TABLE APP B-1-1

EXCERPT FROM  
49CFR 172.101 HAZARDOUS MATERIALS TABLE

(2) Hazardous materials descriptions and proper shipping names	(3) Hazard class	(3A) Identifi- cation number	(4) Label(s) required (if not excepted)	(5) Packaging	
				(a) Exceptions	(b) Specific require- ments
Sodium, metal or metallic (RQ-1000/454)	Flammable solid	UN1428	Flammable solid & Dangerous when wet	None	173.206
Sodium potassium alloy (liquid) (RQ-1000/454)	Flammable solid	UN1422	Flammable solid & Dangerous when wet	None	173.206
Sodium potassium alloy (solid) (RQ-1000/454)	Flammable solid	UN1422	Flammable solid & Dangerous when wet	None	173.206
Denatured alcohol	Flammable liquid	NA1986	Flammable liquid	173.118	173.125

1.1 EXAMPLE I -- Offsite shipment of a sodium-bonded, double-welded, stainless steel capsule containing structural specimens for irradiation. Sodium (40 g) is used as a heat transfer medium. Assume truck transportation.

1. Determine the proper shipping name (Column 2), the hazard class (Column 3) and the identification number (Column 3A). Example: Sodium, metal (or Sodium, metallic); Flammable solid; UN1428. Hazardous substance determination from 172.101 Appendix: 10 1b RQ.

## SHIPMENT EXAMPLES

2. Determine the required packaging from Column 5. Column 5(a) references any applicable exceptions. None is listed for sodium. Column 5(b) references specific requirements for the HM. Those for sodium are given in 173.206. 173.206(a) states: "Metallic sodium or potassium... must be packaged as follows...". Further search takes us to 173.206(a)(10), which states:

"Tubes of stainless steel, or other metals of equivalent strength and nonreactivity, having sealed, welded end caps, and containing not more than 50 grams of metal. Authorized only for metallic sodium, metallic lithium, metallic potassium, and sodium potassium alloy. Each tube must be enclosed within a secondary sealed metallic tube and further enclosed within strong tight outer packaging."

Strong tight packaging is so designed and constructed and its contents so limited that under conditions normally encountered during transportation:

- There will be no significant release of the hazardous materials to the environment;
- The effectiveness of the packaging will not be substantially reduced; and
- There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, or through an explosion, significantly reduce the effectiveness of the packaging.

Strong tight containers may be made of many different materials, e.g., cardboard boxes, sealed tin cans, etc., as long as the finished container meets these criteria.

3. Determine the labels required. Column 4 shows that both FLAMMABLE SOLID and DANGEROUS WHEN WET labels are required on the package. One of each is sufficient, and they must be placed near the proper shipping name marking on the package.
4. Determine the markings required on the package. Marking should be done with 0.5 in. high letters.
- 172.301 states that the package shall be marked with the proper shipping name and the identification number (preceded by UN or NA, as appropriate). For the shipment use SODIUM, METAL (or SODIUM METALLIC), UN1428.
  - 172.306 states that the package must be marked with the name and address of the consignee or the consignor, as appropriate.

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5. Label, mark and address the package(s) as directed above. See Figure APP B-1-1.
6. Determine the vehicle placarding requirement. (See 172.504.) FLAMMABLE SOLID placard is required for this sodium shipment.
7. Fill out and complete the Hazardous Materials Shipment Record. See Exhibit APP B-1-1. Remember, the information supplied here is used by Traffic (in the case of offsite shipment) to fill out the shipping papers.
8. Arrange transportation. Advise driver and furnish placards unless the truck is permanently placarded.

Note: Other problems may occur when making HM shipments. Inspection of the 49 CFR 172.101 table from which Table APP J-1-1 and 172.101 Appendix table shows the sodium classified as hazardous substance in addition to being a hazardous material, and has a reportable quantity (RQ) of 10 lb or 4.54 kg. The amount of sodium shipped in this example is only 40 g. Had it been 10 lb or more the letters RQ would also have to be entered along with the proper shipping name on the package and on the shipping papers, 172.203(c)(2).

1.2 EXAMPLE II -- Onsite shipment of two 55-gal drums of denatured alcohol. Flash point, 50°F. Assume truck transportation.

1. Determine the proper shipping name (Column 2), the hazard class (Column 3) and the identification number (Column 3A). Example: Denatured alcohol, Flammable liquid, NA1986. Hazardous substance determination from 172.101 Appendix table: not listed, no RQ involved.
2. Determine the packaging requirements (Column 5). Exceptions [Column 5(a)] exist and are defined in 173.118. These exceptions do not apply, however, since they deal in quantities much smaller than those involved in shipment or with a flash point of 73°F or higher. Specific packaging requirements [Column 5(b)] direct us to 173.125, which states: "....alcohol, n.o.s., which is classed as flammable liquid, must be packaged as follows: (1) In containers as prescribed in 173.119(a) and (b)." Both references provide for either a 17E or 17C drum (49 CFR 178.115 or 178.116).
3. Determine the labels required. Column 4 shows that a FLAMMABLE LIQUID label must be affixed to each drum. 172.406(a) requires that this label must be affixed to the package near the marked proper shipping name. One label is sufficient so long as no radioactive material is present and the package has volume less than 64 ft<sup>3</sup>, 479 gal, [172.406(3)].

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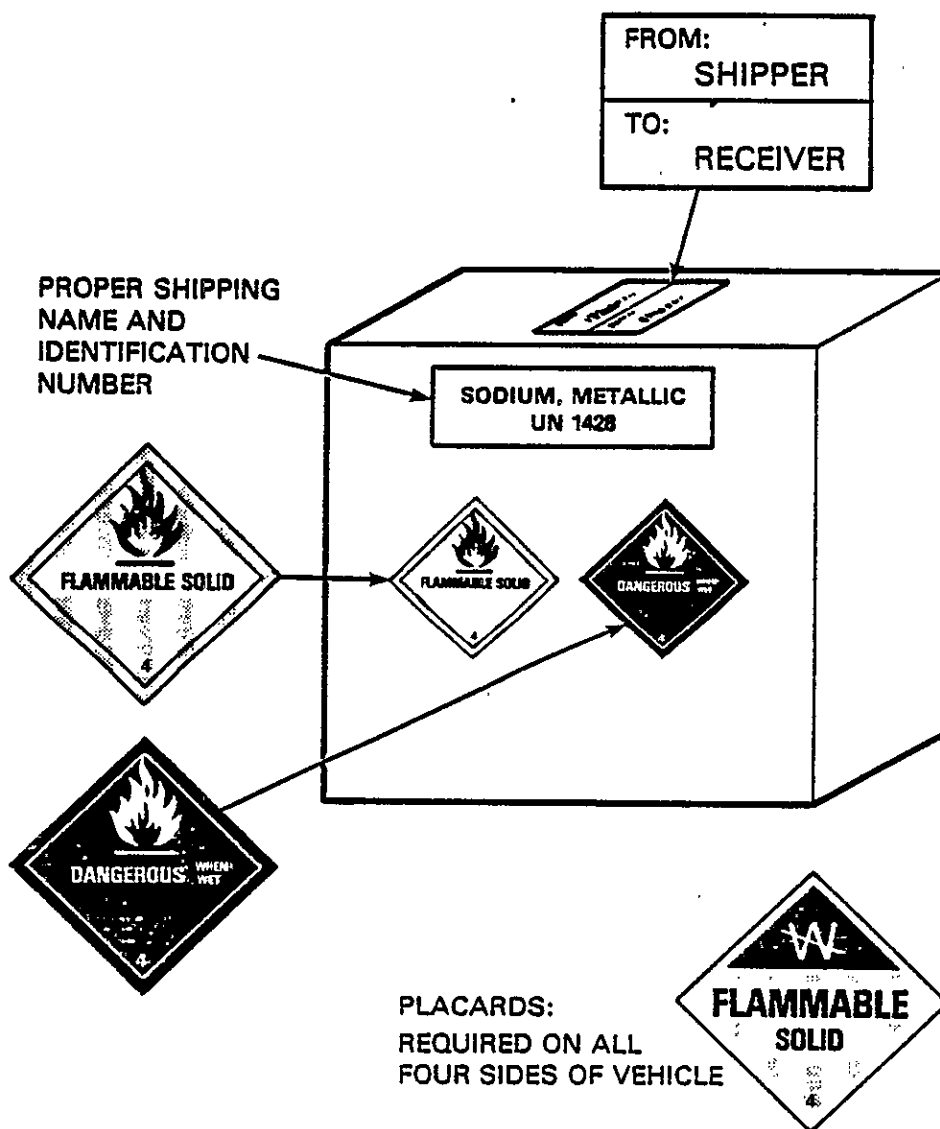
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4. Determine the markings required on the package. Marking shall be done with 0.5 in. high letters.

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Figure APP B-1-1. Package, labeled, marked and addressed.

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SHIP TO:		HAZARDOUS MATERIAL SHIPMENT RECORD (HMSR)				
SHIPPING INST.	Company <b>ALL GONE LAB</b>	Originating Facility Building <b>306</b> Area <b>300</b>	Originator Signature 	Date <b>XX/XX/XX</b>		
	Address <b>1865 CIVIL WAR AVE.</b>	FROM: <input checked="" type="checkbox"/> WHC <input type="checkbox"/> KEH <input type="checkbox"/> PNL <input type="checkbox"/> OTHER				
	City, State, Zip <b>ANYWHERE, XX 12345</b>	OFFSITE ONLY: SHIP: <input checked="" type="checkbox"/> PREPAID <input type="checkbox"/> COLLECT				
	Attention <b>J. DOE</b>	VIA: <input type="checkbox"/> Parcel Post <input type="checkbox"/> Air Parcel Post <input checked="" type="checkbox"/> Freight (Rail/Truck) <input type="checkbox"/> Air (Passenger) <input type="checkbox"/> Air (Cargo)		Cost Code: <b>VG1861 WAZHAP</b>		
SHIPMENT DESCRIPTION	CONTAINERS/PACKAGING				CONTENT DESCRIPTION	
	Number of Containers	Type	DOT Spec	Package Dimensions	Quantity Pkg	Gross Wt Each Pkg
	1	WOOD BOX	15A	8x8x62"	1 CAPSULE 40g SODIUM	40 lbs
						See 49 CFR 172.101(c) Hazardous Material Table
						Proper Ship Name: <b>SODIUM, METAL</b> Hazard Class: <b>FLAMMABLE SOLID</b> UN/NA No.: <b>UN 1428</b> List Secondary Hazards: <b>NONE</b> List Labels Req'd/Applied: <b>FLAMMABLE SOLID and DANGEROUS WHEN WET</b>
						Proper Ship Name: Hazard Class: UN/NA No.: List Secondary Hazards: List Labels Req'd/Applied:
						Proper Ship Name: Hazard Class: UN/NA No.: List Secondary Hazards: List Labels Req'd/Applied:
	Total No. Containers <b>1</b>		Gross Wt of Shipment <b>40 lbs</b>		Identify Placards Required: 1. <b>FLAMMABLE SOLID-W</b> 3. _____ 2. _____ 4. _____	
					Identify Property Control or Return Order No.: (if applicable) <b>WHC-83-XXXX</b>	
	Material in manufacturers original container: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Describe Internal Packaging: <b>40g SODIUM IN DOUBLE WELDED SST CAPSULE</b> <b>PACKED IN VERMICULITE IN DOT SPECIFICATION</b> <b>15A BOX</b>			
Container free of deterioration or damage: <input checked="" type="checkbox"/> Yes						
Container acceptability documented: <input checked="" type="checkbox"/> Yes						
Material is packaged, sealed, marked and labelled to meet DOT requirements <input checked="" type="checkbox"/> Yes						
RADIATION RELEASE	Survey No. <b>XXXXXX</b>	Date <b>XX/XX/XX</b>	RM Signature 	Print Name <b>XX XXXXXXXXXXXX</b>		
CERTIFICATION						
CONTRACTORS CERTIFICATION	This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation:			This shipment is within the Limitations prescribed for: <input type="checkbox"/> Passenger Aircraft <input type="checkbox"/> Cargo Aircraft <input type="checkbox"/> NA		
	Authorizing Signature:  Print Name: <b>XX XXXXXXXXX</b> Date: <b>XX/XX/XX</b>					
FOR OFFSITE SHIPMENTS - ADDITIONAL APPROVAL REQUIRED						
WHC	TRAFFIC	B.L. No.	Date Shipped	ETA	Routing	
		Special Considerations				
		WHC Traffic: _____		WHC Shipping: _____		

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Exhibit APP B-1-1. Hazardous Materials Shipment Record.

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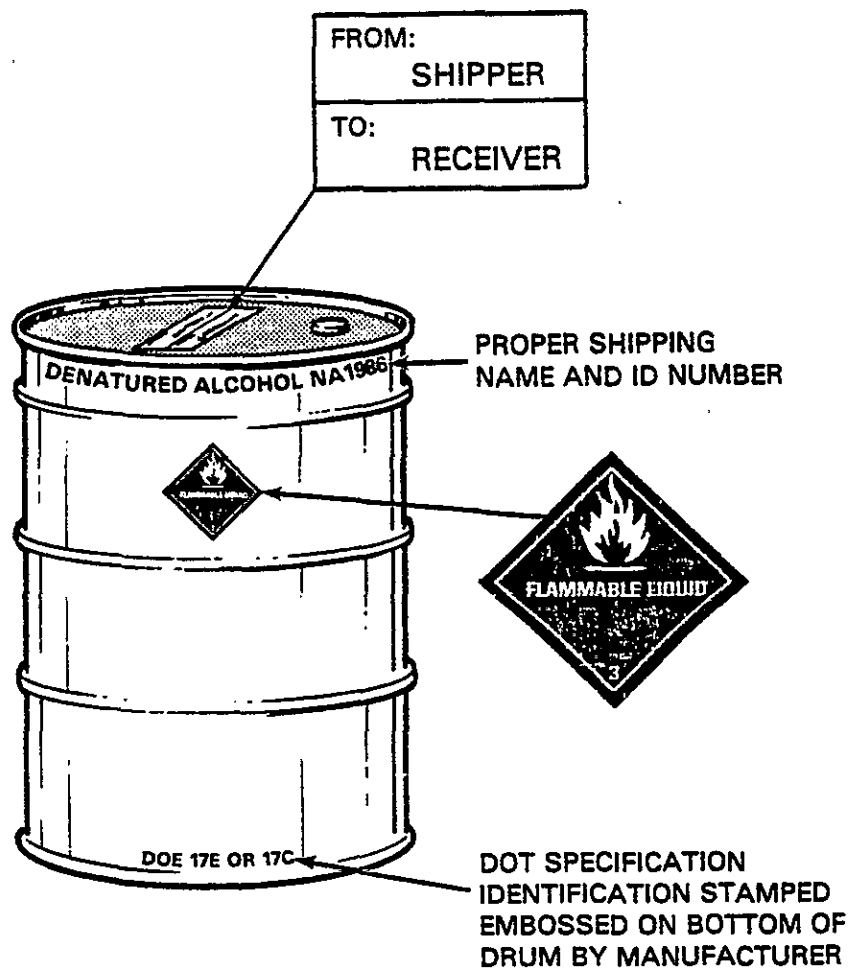
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- 172.301 states that the packages shall be marked with the proper shipping name and the identification number. From the above steps, these are: Denatured alcohol, NA1986.
  - 172.306 states that the package must also be marked with the name and address of the consignee or consignor, as appropriate.
5. Label, mark and address the packages as directed above. See Figure APP B-1-2.
  6. Determine the vehicle placarding requirements (172.504). No placarding of the vehicle is required since the two drums of alcohol weigh less than 1000 lb [172.504(c)(1)]. Alcohol weighs 6.8 lb/gal; therefore 55 gallons weighs about 375 pounds. Allowing about 40 lb for an empty drum, each drum of alcohol weighs a maximum of 415 lb, or 830 lb total for two drums.
  7. Complete the Hazardous Materials Shipment Record using the above data. See Exhibit APP B-1-2.
  8. Arrange transportation.

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Figure APP B-1-2. Package, labeled, marked, and addressed



PLACARDS: NONE REQUIRED FOR THIS SHIPMENT

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## Exhibit APP B-1-2. Hazardous Materials Shipment Record.

SHIP TO:		HAZARDOUS MATERIAL SHIPMENT RECORD (HMSR)									
SHIPPING INST.	Company <b>WESTINGHOUSE</b>	Originating Facility Building <b>324</b> Area <b>300</b>	Originator Signature <i>[Signature]</i>	Date <b>XX/XX/XX</b>							
	Address <b>BLDG. 4983</b>	FROM: <input checked="" type="checkbox"/> WHC <input type="checkbox"/> KEH <input type="checkbox"/> PNL <input type="checkbox"/> OTHER									
	City, State, Zip <b>400 AREA</b>	OFFSITE ONLY: SHIP: <input type="checkbox"/> PREPAID <input type="checkbox"/> COLLECT									
	Attention: <b>J.B. DOE</b>	VIA: <input type="checkbox"/> Parcel Post <input type="checkbox"/> Air Parcel Post <input type="checkbox"/> Freight (Rail/Truck) <input type="checkbox"/> Air (Passenger) <input type="checkbox"/> Air (Cargo) Cost Code: (IF APPLICABLE)									
SHIPMENT DESCRIPTION	CONTAINERS/PACKAGING					CONTENT DESCRIPTION					
	Number of Containers	Type	DOT Spec	Package Dimensions	Quantity Pkg	Gross Wt Each Pkg	See 49 CFR 172.101(c) Hazardous Material Table				
	2	DRUM	17C	55 GAL	55 GAL	415 lbs	Proper Ship Name: <b>DENATURED ALCOHOL</b> Hazard Class: <b>FLAMMABLE LIQUID</b> UN/NA No.: <b>NA 1986</b> List Secondary Hazards: <b>NONE</b> List Labels Req'd/Applied: <b>FLAMMABLE LIQUID</b>				
							Proper Ship Name: Hazard Class: UN/NA No.: List Secondary Hazards: List Labels Req'd/Applied:				
							Proper Ship Name: Hazard Class: UN/NA No.: List Secondary Hazards: List Labels Req'd/Applied:				
	Total No. Containers		Gross Wt of Shipment		Identify Placards Required:		Identify Property Control or Return Order No. (if applicable)				
	2		830 lbs		1. <b>NONE</b> 3. _____ 2. _____ 4. _____		<b>NA</b>				
	Material in manufacturers original container: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Container free of deterioration or damage: <input checked="" type="checkbox"/> Yes Container acceptability documented: <input checked="" type="checkbox"/> Yes Material is packaged, sealed, marked and labelled to meet DOT requirements <input checked="" type="checkbox"/> Yes						Describe Internal Packaging: <b>110 GAL DENATURED ALCOHOL IN TWO 55 GAL DRUMS.</b>				
	RADIATION RELEASE		Survey No. <b>XXXXXX</b>	Date <b>XX/XX/XX</b>	RM Signature <i>[Signature]</i>		Print Name <b>XX XXXXXXXX</b>				
	CONTRACTORS CERTIFICATION		This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transport according to the applicable regulations of the Department of Transportation: Authorizing Signature: <i>[Signature]</i> Print Name <b>SS SSSSSS</b> Date: <b>XX/XX/XX</b>				This shipment is within the Limitations prescribed for: <input type="checkbox"/> Passenger Aircraft <input type="checkbox"/> Cargo Aircraft <input type="checkbox"/> NA				
FOR OFFSITE SHIPMENTS - ADDITIONAL APPROVAL REQUIRED											
WHC	TRAFFIC	B.L. No.	Date Shipped	ETA	Routing	Special Considerations					
		WHC Traffic: _____		WHC Shipping: _____							

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## RADIOACTIVE MATERIAL CHARACTERIZATION

## 1.0 RADIOACTIVE MATERIAL CHARACTERIZATION

The shipper must properly describe the radioactive material on the RSR for shipment. This includes: [See 49 CFR 172.203(d)]

- o Proper Shipping Name, Hazard Class, ID Number and Quantity (Wt., Vol., etc.)
- o Radionuclides packaged (Sr-90, Am-241)
- o Physical and chemical form (solid, oxide)
- o Activity in each package (Ci)
- o Labeling (White-I, Yellow-II, Yellow-III)
- o Transport Index (TI = 1.0)
- o Fissile class (I, II, III)
- o Container used (Certificate of Compliance ID Number)
- o Other information

Considering the large number of radionuclides, there could be almost endless combinations of shipment/package possibilities. Fortunately, the number of radionuclides normally shipped at Hanford is only a small fraction of those possible, and the number is still further reduced when the specific nuclides shipped at any one facility are considered.

This Appendix discusses radioactive material characterization for shipments. The Glossary, Appendix E, defines radioactive material for both onsite and offsite shipments.

## 1.1 RADIOACTIVE MATERIAL WITH OTHER HAZARDOUS MATERIAL PROPERTIES

In some cases, radioactive material may be associated with other hazardous materials either in chemical combination or as a mixture. The presence of these secondary hazards must be addressed in the shipping papers. Modified packaging and labeling may be required. A list of these hazardous constituents are given in 49 CFR Part 172 or in EPA 40 CFR 260-265. Radioactive wastes containing hazardous constituents are termed "mixed wastes" and require special treatment in handling and shipping. (See WHC-EP-0063, Hanford Radioactive Solid Waste Packaging, Storage and Disposal Requirements).

## 1.2 RADIONUCLIDES AND THEIR ACTIVITIES

Each radioactive shipment description must include an estimate of the total activity as well as a list of the radionuclides involved. The originator of the shipment must supply this information since he presumably is most familiar with the material. Several methods for the estimation of activities are available. For example:

- o Radioactive counting methods that identify and measure radionuclide disintegration rates in a sample.

## RADIOACTIVE MATERIAL CHARACTERIZATION

- o Computer programs relating the irradiation history and radioactive decay of the material. FFTF Core Engineering generates these programs to identify nuclides and their activities in FFTF fuel assemblies.
- o Calculations based on physical weight, chemical and isotopic analyses, and specific activities of the radioisotopes. Table APP C-1 shows some examples of plutonium feed materials for FFTF. Similar data could be developed for other source, feed, and product materials.
- o Calculations from unshielded exposure rate measurements of irradiated material at a specific distance and an assumed average spectral energy of the radiation giving the dose rate. Accuracy of this method is relatively poor compared to those above, but in some cases the only choice available. Table APP C-2 gives some dose rates at one centimeter and one foot from some unshielded one curie radionuclide sources. Included along with this table are some example calculations.
- o Calculations based on exposure through shielding when the composition and thickness of the shielding, as well as the energy of the principal emissions are known. This is the least accurate method.

For onsite and offsite movement, radionuclides must be clearly identified by symbol and isotopic weight (e.g.,  $^{239}\text{Pu}$ ,  $^{235}\text{U}$ , or Pu-239, U-235). If fissile material is being described, the mass of material present is as significant as its activity in curies. The number in grams must also be indicated to assure compliance with criticality requirements.

### 1.3 UNITS OF RADIOACTIVITY

The activity of a RAM shipment must be expressed in units of curies, millicuries, etc. The following list shows a few of the more widely used expressions of activity and their acceptable abbreviations, as well as some conversion factors.

$$1 \text{ curie} = \text{Ci} = 3.7 \times 10^{10} \text{ dps}^* = 2.22 \times 10^{12} \text{ dpm}^{**}$$

$$1 \text{ millicurie} = \text{mCi} = 3.7 \times 10^7 \text{ dps} = 2.22 \times 10^9 \text{ dpm}$$

$$1 \text{ microcurie} = \text{uCi} = 3.7 \times 10^4 \text{ dps} = 2.22 \times 10^6 \text{ dpm}$$

$$1 \text{ nanocurie} = \text{nCi} = 3.7 \times 10 \text{ dps} = 2.22 \times 10^3 \text{ dpm}$$

$$1 \text{ picocurie} = \text{pCi} = 3.7 \times 10^{-2} \text{ dps} = 2.22 \text{ dpm}$$



\* dps = disintegrations per second    \*\* dpm disintegration per minute

ACTIVITY UNITS

Multiply no. of \_\_\_\_\_ by \_\_\_\_\_ to obtain no. of

to obtain no. of \_\_\_\_\_ by \_\_\_\_\_ Divide no. of

curies                                       $10^3$                                       millicuries

curies                                       $10^6$                                       microcuries

curies                                       $10^{12}$                                       picocuries

All radioactive material shipments transported by air, whether domestic or international, must comply with the International Air Transport Association (IATA) Dangerous Goods Regulations. The IATA requires all activities be expressed in the International System of Units (SI) as well as the more traditional units. The traditional and SI units are compared in Appendix E. (See International System of Units).

#### 1.4 QUANTITY CATEGORIES

The amounts of the radionuclides to be shipped in a given package must be compared with the  $A_1$  and  $A_2$  values assigned for each of the radionuclides given in 49 CFR 173.435. Applying the specific multiplication factors (1/1000, 1, 3000) to these  $A_1$  and  $A_2$  values gives the quantity ranges for these radionuclides to be shipped, defines the quantity categories involved and further decides the type of container to be used. Tables APP C-3 and APP C-4 show the quantity values for Special Form ( $A_1$ ) and Normal Form ( $A_2$ ) respectively.

##### 1.4.1 Treatment of Unknown and Mixtures of Radionuclides

The estimation of activity for a shipment of unknown and mixed radionuclides requires special attention. Directions for these situations are given in 49 CFR 173.433. For example, consider the following use of the unity rule or the sum of the fractions rule:

EXAMPLE: Assume a normal for mixture of 0.001 mCi of Pu-239 and 0.04 mCi of U-233. Can this mixture be shipped as a limited quantity?

First determine the ratios of the activity for each radionuclide present to its  $A_2/1000$  value allowed for a limited quantity. Limited quantities ( $A_2/1000$ ) for Pu-239 and U-233 separately are 0.002 mCi and 0.1 mCi, respectively. The calculated ratios then are:  $0.001/0.002 = 0.5$  for Pu-239 and  $0.04/0.1 = 0.4$  for U-233. The sum of these ratios is 0.9,

which is less than one (unity). Therefore, this mixture can qualify as a limited quantity with all the rights and privileges of a limited quantity.

Additional directions for this example and other situations are given in 49 CFR 173.433.

## 1.5 OTHER TABLES

Table APP C-5 shows the specific activities of the radionuclides.

Table APP C-6 gives the activity-mass relationships for depleted, natural and enriched uranium.

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TABLE APP C-1

CURIE AND ISOTOPIC CONTENTS OF SOME TYPICAL  
FFTF PLUTONIUM FEED MATERIALS

9  
0  
1  
1  
7  
7  
3  
0  
5  
9  
6

TABLE APP C-1

## CURIE AND ISOTOPIC CONTENTS OF SOME TYPICAL FFTF PLUTONIUM FEED MATERIALS

Isotope	Specific Activity (Ci/g Iso)	FFTF Type Pu 12% Pu-240		High Expos Pu 17% Pu-240		High Expos Pu 19% Pu-240	
		wt/fr Iso	Ci/Iso	wt/fr Iso	Ci/Iso	wt/fr Iso	Ci Iso
Pu-238	16.8	0.00046	0.008	0.00241	0.040	0.00197	0.033
Pu-239	0.0617	0.8681	0.054	0.7906	0.049	0.763	0.047
Pu-240	0.227	0.1166	0.026	0.1678	0.038	0.195	0.044
Pu-241 ( )	114.0	0.0129	1.471	0.0306	3.488	0.028	3.192
Pu-242	0.0039	0.00189	0.00001	0.0087	0.00003	0.0117	0.00005
	TOTAL + (Ci/g Pu)		1.558		3.616		3.316
	(Ci/g Pu)		0.087		0.128		0.124

\*wt = weight, fr = fraction, Iso = Isotope.

TABLE APP C-2

1. GAMMA DOSE RATES FROM VARIOUS ISOTOPIC SOURCES\*
2. SAMPLE CALCULATIONS - ESTIMATION OF ACTIVITY

\* Health Physics Handbook, OSP 379, General Dynamics,  
Fort Worth, April 1963.

9 6 5 0 3 7 2 1 1 0 3

TABLE APP C-2

## 1. GAMMA DOSE RATES FROM VARIOUS ISOTOPIC SOURCES

Isotopic	Half-Life	Energy in MEV (Percent Abundance)	Roentgens Per Hour Per Curie	
			At 1 CM	At 1
Foot				
Au-198	2.69 d	0.4118(95), 0.676(0.82), 1.089(0.16)	2,480	2.65
As-76	26.5 hr.	0.55(41), 0.64(8), 1.20(9), 1.4(.08), 2.05(1.6)	2,300	2.46
Br-82	35.9 hr.	Many up to 1.5	14,600	5.62
Co-58	71.0 d	.81(100)1.62(0.5) +(14)	5,300	5.67
Co-60	5.25 yr.	1.17(100), 1.33(100)	12,800	13.69
Cs-137	30.0 yr.	.662(82)	3,100	3.31
Cu-64	12.8 hr.	1.34(.05) +(100)	1,140	1.22
Fe-59	45.1 d	1.10(57), 1.29(43)	6,800	7.28
Ga-72	14.1 d	0.63(21), 0.83(83), 0.89(10), 2.20(30), 2.49(10), 2.51(17)	12,300	13.16
Hg-203	47 d	0.279(83)	1,100	1.18
I-128	25 m	0.46(16), 0.54(1)	450	0.48
I-130	12.5 hr.	0.41(23), 0.53(100), 0.66(100) 0.74(69), 1.15(29)	12,000	12.84
I-131	8.04 d	0.08(2), 0.28(5), 0.36(80), 0.64(9), 0.72(3)	2,500	2.41
Ir-192	74.4 d	Many up to 0.6	5,000	5.35
K-42	12.5 hr.	1.53(18)	1,520	1.63
Mn-52	5.7 d	0.73(100), 0.94(100), 1.45(100), +(33)	19,700	21.08
Mn-54	291 d	0.84(100)	4,700	5.03
Na-22	2.6 yr.	1.28(100), +(89)	11,600	12.41

TABLE APP C-2 (Continued)

## 1. GAMMA DOSE RATES FROM VARIOUS ISOTOPIC SOURCES

Isotopic	Half-Life	Energy in MEV (Percent Abundance)	Roentgens Per Hour Per Curie	
			At 1 CM	At 1
<u>Foot</u>				
Na-24	15.0 hr.	1.37(100), 2.06(100)	18,700	20.01
Ra-226	1590 yr.	.186 (5.7%)	8,440	9.03
Ta-182	111 d	Many up to 1.219	5,690	6.13
Tm-170	127 d	0.084(3) and Bremsstrahlung from -(0.87, 0.97 Mev)	40	0.04
Zn-65	245 d	1.11(45) +(2)	2,800	1.93

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## 2. SAMPLE CALCULATIONS

ESTIMATION OF ACTIVITY

A useful rule of thumb will give the activity of a source of gamma radiation to within  $\pm 20\%$  (for photon energies between 70 keV and 4 MeV), if the exposure rate and distance from the source are known. The activity (in mCi) may be calculated from the following formula:

$$A = \frac{X}{6Ef}, \text{ at a distance of 1 ft}$$

where:

A = Activity (mCi)

E = Energy (MeV)

X = Exposure rate (mR/h)

f = Fraction of disintegrations resulting in photons of energy E

If the source emits photons of more than one energy, the activity due to each one must be separately calculated and summed in order to determine total activity.

$$\frac{X(\text{mR/h})}{6(Ef)}$$

When distance is expressed in cm rather than ft, the expression becomes:

$$A = \frac{X}{5000(Ef)}$$

If the radiation measurement is not made at a distance of 1 ft or 1 cm, use of Inverse Square Law will allow this expression to apply to a source of radiation from any distance. (Correction for distance must be made first.)

$$\frac{X_1}{X_2} = \frac{(d_2)^2}{(d_1)^2}$$



## 2. SAMPLE CALCULATIONS (Continued)

Example 1

Calculate the activity of an unshielded source of Co-60 that reads 13.8 mR/h at 1 ft.

Co-60 emits 2 photons per disintegration:

$$1 = 1.17 \text{ (100\% abundance)}$$

$$2 = 1.33 \text{ (100\% abundance)}$$

$$X = 13.8 \text{ mR/h at 1 ft}$$

$$A = \frac{13.8}{6[(1.17)(1.0) + (1.33)(1.0)]}$$

$$= 0.92 \text{ mCi}$$

This activity value is within 20% of the actual activity of this sample, which is 1.0 mCi.

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## 2. SAMPLE CALCULATIONS (Continued)

Example 2

Calculate the activity of an I-131 source that reads 2.2 R/h at a distance of 1 cm.

I-131 emits photons of 5 separate energies:

$$0.080 \text{ MeV (2.6\% abundance), } E_f = .080 \times .026 = .002$$

$$0.284 \text{ MeV (5.4\% abundance), } E_f = .284 \times .054 = .015$$

$$0.364 \text{ MeV (82.0\% abundance), } E_f = .364 \times .82 = .299$$

$$0.637 \text{ MeV (6.8\% abundance), } E_f = .637 \times .068 = .043$$

$$0.723 \text{ MeV (1.6\% abundance), } E_f = .723 \times .016 = .012$$

$$X = 2200 \text{ mR/h at 1 cm}$$

$$A = \frac{2200}{5000[(0.002) + (0.015) + (0.299) + (0.043) + (0.012)]}$$

$$= \frac{2200}{1854}$$

$$= 1.19 \text{ mCi}$$

As in Example 1, this calculated activity is within 20% of the actual sample activity of 1.0 mCi.

HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

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TABLE APP C-3

ACTIVITY LIMITS FOR RADIONUCLIDES IN  
SPECIAL FORM

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HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

## RADIOACTIVE MATERIAL CHARACTERIZATION

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TABLE APP C-3

Special Form Only  
Activity Limits for Radionuclides in Special Form.  
(All values in curies (Ci) unless otherwise stated.)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_1/1,000$ )	Type A qty ( $\leq A_1$ )	Type B qty ( $> A_1$ )	Highway Route generalized quantity ( $3,000 \times A_1$ or 30K)
227Ac	Actinium (89)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
228Ac	Actinium (89)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
105Ag	Silver (47)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
110mAg	Silver (47)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21K$
111Ag	Silver (47)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30K$
241Am**	Americium (95)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 24K$
243Am	Americium (95)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 24K$
37Ar (Comp/Uncomp)	Argon (18)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
41Ar (Uncomp)	Argon (18)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
41Ar (Comp)	Argon (18)	$\leq 0.001$	$\leq 1.0$	$> 1.0$	$\geq 3K$
73As	Arsenic (33)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
74As	Arsenic (33)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
76As	Arsenic (33)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
77As	Arsenic (33)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30K$
211At	Astatine (85)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
193Au	Gold (79)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
196Au	Gold (79)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
198Au	Gold (79)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
199Au	Gold (79)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
131Ba	Barium (56)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
133Ba	Barium (56)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
140Ba	Barium (56)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
7Be	Beryllium (4)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30K$
206Bi	Bismuth (83)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15K$
207Bi	Bismuth (83)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
210Bi (RaE)	Bismuth (83)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30K$
212Bi	Bismuth (83)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15K$
249Bk	Berkelium (97)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
77Br	Bromine (35)	$\leq 0.07$	$\leq 70$	$> 70$	$\geq 30K$
82Br	Bromine (35)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15K$
11C	Carbon (6)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
14C	Carbon (6)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
45Ca	Calcium (20)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
47Ca	Calcium (20)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
109Cd	Cadmium (48)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
115mCd	Cadmium (48)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
115Cd	Cadmium (48)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30K$
139Ce	Cerium (58)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30K$
141Ce	Cerium (58)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30K$
143Ce	Cerium (58)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30K$
144Ce	Cerium (58)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
249Cf	Californium (98)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6K$
250Cf	Californium (98)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21K$
252Cf	Californium (98)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6K$
36Cl	Chlorine (17)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30K$
38Cl	Chlorine (17)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
242Cm	Curium (96)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
243Cm	Curium (96)	$\leq 0.009$	$\leq 9$	$> 9$	$\geq 27K$
244Cm	Curium (96)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
245Cm	Curium (96)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18K$
246Cm	Curium (96)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18K$
56Co	Cobalt (27)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15K$
57Co	Cobalt (27)	$\leq 0.09$	$\leq 90$	$> 90$	$\geq 30K$
58mCo	Cobalt (27)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
58Co	Cobalt (27)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
60Co	Cobalt (27)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21K$
51Cr	Chromium (24)	$\leq 0.6$	$\leq 600$	$> 600$	$\geq 30K$
129Cs	Cesium (55)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
131Cs	Cesium (55)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
134mCs	Cesium (55)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_1$  value by 10,000.\*\*For shipments solely within the United States the  $A_1$  value is 20 Ci for americium and plutonium contained in Am-Be or Pu-Be neutron sources or in nuclear-powered pacemakers.

TABLE APP C-3 (Continued)

Special Form Only  
Activity Limits for Radionuclides in Special Form. (All values  
in curies (Ci) unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_1/1,000$ )	Type A qty ( $\leq A_1$ )	Type B qty ( $> A_1$ )	Highway Route controlled quantity ( $3,000 \times A_1$ or 30K)
$^{134}\text{Cs}$	Cesium (55)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{135}\text{Cs}$	Cesium (55)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{136}\text{Cs}$	Cesium (55)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{137}\text{Cs}$	Cesium (55)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{64}\text{Cu}$	Copper (29)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{67}\text{Cu}$	Copper (29)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{166}\text{Dy}$	Dysprosium (66)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{166}\text{Dy}$	Dysprosium (66)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{168}\text{Er}$	Erbium (68)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{171}\text{Er}$	Erbium (68)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{152}\text{Eu}$	Europium (63)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{152}\text{Eu}$	Europium (63)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{154}\text{Eu}$	Europium (63)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{155}\text{Eu}$	Europium (63)	$\leq 0.4$	$\leq 400$	$> 400$	$\geq 30\text{K}$
$^{18}\text{F}$	Fluorine (9)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{52}\text{Fe}$	Iron (26)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15\text{K}$
$^{55}\text{Fe}$	Iron (26)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{59}\text{Fe}$	Iron (26)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{67}\text{Ga}$	Gallium (31)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{68}\text{Ga}$	Gallium (31)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{72}\text{Ga}$	Gallium (31)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{153}\text{Gd}$	Gadolinium (64)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{159}\text{Gd}$	Gadolinium (64)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{68}\text{Ge}$	Germanium (32)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{71}\text{Ge}$	Germanium (32)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^3\text{H}$	Hydrogen (1)	†	†	†	†
$^{181}\text{Hf}$	Hafnium (72)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{197}\text{Hg}$	Mercury (80)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{197}\text{Hg}$	Mercury (80)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{203}\text{Hg}$	Mercury (80)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{166}\text{Ho}$	Holmium (67)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{123}\text{I}$	Iodine (53)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{125}\text{I}$	Iodine (53)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{126}\text{I}$	Iodine (53)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{129}\text{I}$	Iodine (53)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{131}\text{I}$	Iodine (53)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{132}\text{I}$	Iodine (53)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{133}\text{I}$	Iodine (53)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{134}\text{I}$	Iodine (53)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 24\text{K}$
$^{136}\text{I}$	Iodine (53)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{111}\text{In}$	Indium (49)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{113}\text{mIn}$	Indium (49)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{114}\text{mIn}$	Indium (49)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{115}\text{mIn}$	Indium (49)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{190}\text{Ir}$	Iridium (77)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{192}\text{Ir}$	Iridium (77)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{194}\text{Ir}$	Iridium (77)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{42}\text{K}$	Potassium (19)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{43}\text{K}$	Potassium (19)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{85\text{m}}\text{Kr}$ (Uncomp)	Krypton (36)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{85\text{m}}\text{Kr}$ (Comp)	Krypton (36)	$\leq 0.003$	$\leq 3$	$> 3$	$\geq 9\text{K}$
$^{86}\text{Kr}$ (Uncomp)	Krypton (36)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{86}\text{Kr}$ (Comp)	Krypton (36)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15\text{K}$
$^{87}\text{Kr}$ (Uncomp)	Krypton (36)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{87}\text{Kr}$ (Comp)	Krypton (36)	$\leq 0.0006$	$\leq 0.6$	$> 0.6$	$\geq 1,800$
$^{140}\text{La}$	Lanthanum (57)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
LSA (Low Specific Activity)	See 173.403 (n)				
$^{177}\text{Lu}$	Lucentium (71)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
MFP	Mixed fission products	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{25}\text{Mg}$	Magnesium (12)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18\text{K}$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_1$  value by 10,000.

†See tritium.

TABLE APP C-3 (Continued)

Special Form Only  
Activity Limits for Radionuclides in Special Form. (All values  
in curies [Ci] unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_1/1,000$ )	Type A qty ( $\leq A_1$ )	Type B qty ( $> A_1$ )	Highway Route concentrated quantity ( $3,000 \times A_1$ or 30K)
$^{52}\text{Mn}$	Manganese (25)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{54}\text{Mn}$	Manganese (25)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{56}\text{Mn}$	Manganese (25)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{99}\text{Mo}$	Molybdenum (42)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{13}\text{N}$	Nitrogen (7)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{22}\text{Na}$	Sodium (11)	$\leq 0.008$	$\leq 8$	$> 8$	$\geq 24\text{K}$
$^{24}\text{Na}$	Sodium (11)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{93}\text{Nb}$	Niobium (41)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{95}\text{Nb}$	Niobium (41)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{97}\text{Nb}$	Niobium (41)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{147}\text{Nd}$	Neodymium (60)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{149}\text{Nd}$	Neodymium (60)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{59}\text{Ni}$	Nickel (28)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{63}\text{Ni}$	Nickel (28)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{65}\text{Ni}$	Nickel (28)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{237}\text{Np}$	Neptunium (93)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{239}\text{Np}$	Neptunium (93)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{186}\text{Os}$	Osmium (76)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{191}\text{Os}$	Osmium (76)	$\leq 0.6$	$\leq 600$	$> 600$	$\geq 30\text{K}$
$^{191\text{m}}\text{Os}$	Osmium (76)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{183}\text{Os}$	Osmium (76)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{32}\text{P}$	Phosphorus (15)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{230}\text{Pa}$	Protactinium (81)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{231}\text{Pa}$	Protactinium (81)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6\text{K}$
$^{233}\text{Pa}$	Protactinium (81)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{201}\text{Po}$	Lead (82)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{210}\text{Po}$	Lead (82)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{212}\text{Po}$	Lead (82)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18\text{K}$
$^{103}\text{Pd}$	Palladium (46)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{105}\text{Pd}$	Palladium (46)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{147}\text{Pm}$	Praseodymium (61)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{149}\text{Pm}$	Praseodymium (61)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{210}\text{Po}$	Polonium (84)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{142}\text{Pr}$	Praseodymium (59)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{143}\text{Pr}$	Praseodymium (59)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{191}\text{Pt}$	Platinum (78)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{193\text{m}}\text{Pt}$	Platinum (78)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{197\text{m}}\text{Pt}$	Platinum (78)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{197}\text{Pt}$	Platinum (78)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{238}\text{Pu}^{**}$	Plutonium (94)	$\leq 0.003$	$\leq 3$	$> 3$	$\geq 6\text{K}$
$^{239}\text{Pu}$	Plutonium (94)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6\text{K}$
$^{240}\text{Pu}$	Plutonium (94)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6\text{K}$
$^{241}\text{Pu}$	Plutonium (94)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{242}\text{Pu}$	Plutonium (94)	$\leq 0.003$	$\leq 3$	$> 3$	$\geq 6\text{K}$
$^{223}\text{Ra}$	Radium (88)	$\leq 0.05$	$\leq 50$	$> 50$	$\geq 30\text{K}$
$^{224}\text{Ra}$	Radium (88)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18\text{K}$
$^{226}\text{Ra}$	Radium (88)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{228}\text{Ra}$	Radium (88)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{81}\text{Rb}$	Rubidium (37)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{86}\text{Rb}$	Rubidium (37)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{87}\text{Rb}$	Rubidium (37)	UL††	UL††	UL††	$\geq 30\text{K}$
Rb (Net)	Rubidium (37)	UL††	UL††	UL††	$\geq 30\text{K}$
$^{186}\text{Re}$	Rhenium (75)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{187}\text{Re}$	Rhenium (75)	UL††	UL††	UL††	$\geq 30\text{K}$
$^{188}\text{Re}$	Rhenium (75)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
Re (Net)	Rhenium (75)	UL††	UL††	UL††	$\geq 30\text{K}$
$^{103\text{m}}\text{Rh}$	Rhodium (45)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{105}\text{Rh}$	Rhodium (45)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{222}\text{Rn}$	Radon (86)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{97}\text{Ru}$	Ruthenium (44)	$\leq 0.08$	$\leq 80$	$> 80$	$\geq 30\text{K}$

\*Values given for solids and gases only. For liquids divide value given by 10 or divide the  $A_1$  value by 10,000.\*\*For shipments solely within the United States the  $A_1$  value is 20 Ci for americium and plutonium contained in Am-Be or Pu-Be neutron sources or in nuclear-powered pacemakers.

††Unlimited.

TABLE APP C-3 (Continued)

Special Form Only  
Activity Limits for Radionuclides in Special Form. (All values  
in curies (Ci) unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_1/1,000$ )	Type A qty ( $\leq A_1$ )	Type B qty ( $> A_1$ )	Highway Route controlled quantity ( $3,000 \times A_1$ or 30K)
$^{103}\text{Ru}$	Ruthenium (44)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{106}\text{Ru}$	Ruthenium (44)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{106}\text{Ru}$	Ruthenium (44)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{35}\text{S}$	Sulfur (16)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{122}\text{Sb}$	Antimony (51)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{124}\text{Sb}$	Antimony (51)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{125}\text{Sb}$	Antimony (51)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{48}\text{Sc}$	Scandium (21)	$\leq 0.008$	$\leq 8$	$> 8$	$\geq 24\text{K}$
$^{47}\text{Sc}$	Scandium (21)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{48}\text{Sc}$	Scandium (21)	$\leq 0.008$	$\leq 8$	$> 8$	$\geq 15\text{K}$
$^{75}\text{Se}$	Selenium (34)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{31}\text{Si}$	Silicon (14)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{147}\text{Sm}$	Samarium (62)	UL††	UL††	UL††	$\geq 30\text{K}$
$^{151}\text{Sm}$	Samarium (62)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{153}\text{Sm}$	Samarium (62)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{113}\text{Sn}$	Tin (50)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{115m}\text{Sn}$	Tin (50)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{125}\text{Sn}$	Tin (50)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{86}\text{Sr}$	Strontium (38)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{86}\text{Sr}$	Strontium (38)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{87m}\text{Sr}$	Strontium (38)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{89}\text{Sr}$	Strontium (38)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{90}\text{Sr}$	Strontium (38)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{91}\text{Sr}$	Strontium (38)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{92}\text{Sr}$	Strontium (38)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
T (Uncomp)	Tridium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Comp)	Tridium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Activated luminous paint)	Tridium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Absorbed on solid)	Tridium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Tridated water)	Tridium (1)	$< 0.1$ Ci/iter 0.1-1.0 Ci/iter $> 1.0$ Ci/iter	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (other form)	Tridium (1)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{182}\text{Ta}$	Tantalum (73)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{180}\text{Tb}$	Terbium (65)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{96m}\text{Tc}$	Technetium (43)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{96}\text{Tc}$	Technetium (43)	$\leq 0.008$	$\leq 8$	$> 8$	$\geq 15\text{K}$
$^{97m}\text{Tc}$	Technetium (43)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{97}\text{Tc}$	Technetium (43)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{98m}\text{Tc}$	Technetium (43)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{99}\text{Tc}$	Technetium (43)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{125m}\text{Te}$	Tellurium (52)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{127m}\text{Te}$	Tellurium (52)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{127}\text{Te}$	Tellurium (52)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{129m}\text{Te}$	Tellurium (52)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{129}\text{Te}$	Tellurium (52)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{131m}\text{Te}$	Tellurium (52)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{132}\text{Te}$	Tellurium (52)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{227}\text{Th}$	Thorium (90)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{228}\text{Th}$	Thorium (90)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15\text{K}$
$^{230}\text{Th}$	Thorium (90)	$\leq 0.003$	$\leq 3$	$> 3$	$\geq 30\text{K}$
$^{231}\text{Th}$	Thorium (90)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{232}\text{Th}$	Thorium (90)	UL††	UL††	UL††	$\geq 30\text{K}$
$^{234}\text{Th}$	Thorium (90)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
Th (Nat)	Thorium (90)	UL††	UL††	UL††	$\geq 30\text{K}$
Th (imid)	Thorium (90)	†	†	†	$\geq 30\text{K}$
$^{200}\text{Tl}$	Thallium (81)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{201}\text{Tl}$	Thallium (81)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{202}\text{Tl}$	Thallium (81)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{204}\text{Tl}$	Thallium (81)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_1$  value by 10,000.

††Unlimited

‡The values of  $A_1$  and  $A_2$  must be calculated in accordance with the procedure specified in 49CFR173.433, taking into account the activity of the fission products and of the uranium-233 in addition to that of the thorium.

TABLE APP C-3 (Continued)

Special Form Only  
Activity Limits for Radionuclides in Special Form. (All values  
in curies [Ci] unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_1/1,000$ )	Type A qty ( $\leq A_1$ )	Type B qty ( $> A_1$ )	Highway Route controlled quantity ( $3,000 \times A_1$ or 30K)
$^{170}\text{Tm}$	Thulium (69)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{171}\text{Tm}$	Thulium (69)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{230}\text{U}$	Uranium (92)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{232}\text{U}$	Uranium (92)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{233}\text{U}$	Uranium (92)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{234}\text{U}$	Uranium (92)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{235}\text{U}$	Uranium (92)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{236}\text{U}$	Uranium (92)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{238}\text{U}$	Uranium (92)	UL††	UL††	UL††	$\geq 30\text{K}$
U (Net)	Uranium (92)	UL††	UL††	UL††	$\geq 30\text{K}$
U (Enr<20%)	Uranium (92)	UL††	UL††	UL††	$\geq 30\text{K}$
U (Enr>20%)	Uranium (92)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
U (Depl)	Uranium (92)	UL††	UL††	UL††	$\geq 30\text{K}$
U (ired)	††	††	††	††	$\geq 30\text{K}$
$^{48}\text{V}$	Vanadium (23)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18\text{K}$
$^{181}\text{W}$	Tungsten (74)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{186}\text{W}$	Tungsten (74)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{187}\text{W}$	Tungsten (74)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{127}\text{Xe}$ (Uncomp)	Xenon (54)	$\leq 0.07$	$\leq 70$	$> 70$	$\geq 30\text{K}$
$^{127}\text{Xe}$ (Comp)	Xenon (54)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{131\text{m}}\text{Xe}$ (Comp)	Xenon (54)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{131\text{m}}\text{Xe}$ (Uncomp)	Xenon (54)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{133}\text{Xe}$ (Uncomp)	Xenon (54)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{133}\text{Xe}$ (Comp)	Xenon (54)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{135}\text{Xe}$ (Uncomp)	Xenon (54)	$\leq 0.07$	$\leq 70$	$> 70$	$\geq 30\text{K}$
$^{135}\text{Xe}$ (Comp)	Xenon (54)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6\text{K}$
$^{87}\text{Y}$	Yttrium (39)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{90}\text{Y}$	Yttrium (39)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{91\text{m}}\text{Y}$	Yttrium (39)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{91}\text{Y}$	Yttrium (39)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{92}\text{Y}$	Yttrium (39)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{93}\text{Y}$	Yttrium (39)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{189}\text{Yb}$	Ytterbium (70)	$\leq 0.08$	$\leq 80$	$> 80$	$\geq 30\text{K}$
$^{175}\text{Yb}$	Ytterbium (70)	$\leq 0.4$	$\leq 400$	$> 400$	$\geq 30\text{K}$
$^{65}\text{Zn}$	Zinc (30)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{69\text{m}}\text{Zn}$	Zinc (30)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{67}\text{Zn}$	Zinc (30)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30\text{K}$
$^{93}\text{Zr}$	Zirconium (40)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{95}\text{Zr}$	Zirconium (40)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{97}\text{Zr}$	Zirconium (40)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_1$  value by 10,000.

††Unlimited

‡‡The values of  $A_1$  and  $A_2$  must be calculated in accordance with the procedure specified in 49CFR173.433, taking into account the activity of the fission products and of the plutonium isotopes in addition to that of the uranium.



TABLE APP C-4

ACTIVITY LIMITS FOR RADIONUCLIDES IN  
NORMAL FORM

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HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

## RADIOACTIVE MATERIAL CHARACTERIZATION

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TABLE APP C-4

Normal Form Only  
Activity Limits for Radionuclides in Normal Form.  
(All values in curies [Ci] unless otherwise stated.)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_2/1,000$ )	Type A qty ( $\leq A_2$ )	Type B qty ( $> A_2$ )	Highway Route controlled quantity ( $3,000 \times A_2$ or 30K)
227Ac	Actinium (89)	$\leq 0.003$ mCi	$\leq 0.003$	$> 0.003$	$\geq 9$
228Ac	Actinium (89)	$\leq 0.004$	$\leq 4$	$> 4$	$\geq 12K$
106Ag	Silver (47)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
110mAg	Silver (47)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21K$
111Ag	Silver (47)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
241Am**	Americium (95)	$\leq 0.008$ mCi	$\leq 0.008$	$> 0.008$	$\geq 24$
243Am	Americium (95)	$\leq 0.008$ mCi	$\leq 0.008$	$> 0.008$	$\geq 24$
37Ar (Comp/Uncomp)	Argon (18)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
41Ar (Uncomp)	Argon (18)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
41Ar (Comp)	Argon (18)	$\leq 0.001$	$\leq 1.0$	$> 1.0$	$\geq 3K$
73As	Arsenic (33)	$\leq 0.4$	$\leq 400$	$> 400$	$\geq 30K$
74As	Arsenic (33)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
76As	Arsenic (33)	$\leq 0.1$	$\leq 10$	$> 10$	$\geq 30K$
77As	Arsenic (33)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
211At	Astatine (85)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21K$
193Au	Gold (79)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
196Au	Gold (79)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
198Au	Gold (79)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
199Au	Gold (79)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
131Ba	Barium (56)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
133Ba	Barium (56)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
140Ba	Barium (56)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
7Be	Beryllium (4)	$\leq 0.3$	$\leq 300$	$> 300$	$\geq 30K$
206Bi	Bismuth (83)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15K$
207Bi	Bismuth (83)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
210Bi (RaE)	Bismuth (83)	$\leq 0.004$	$\leq 4$	$> 4$	$\geq 12K$
212Bi	Bismuth (83)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15K$
249Bk	Berkelium (97)	$\leq 0.001$	$\leq 1.0$	$> 1.0$	$\geq 3K$
77Br	Bromine (35)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
82Br	Bromine (35)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15K$
11C	Carbon (6)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
14C	Carbon (6)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30K$
45Ca	Calcium (20)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
47Ca	Calcium (20)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
109Cd	Cadmium (48)	$\leq 0.07$	$\leq 70$	$> 70$	$\geq 30K$
115mCd	Cadmium (48)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
115Cd	Cadmium (48)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
139Ce	Cerium (58)	$\leq 0.01$	$\leq 100$	$> 100$	$\geq 30K$
141Ce	Cerium (58)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
143Ce	Cerium (58)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
144Ce	Cerium (58)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21K$
249Cf	Californium (98)	$\leq 0.002$ mCi	$\leq 0.002$	$> 0.002$	$\geq 6$
250Cf	Californium (98)	$\leq 0.007$ mCi	$\leq 0.007$	$> 0.007$	$\geq 21$
252Cf	Californium (98)	$\leq 0.009$ mCi	$\leq 0.009$	$> 0.009$	$\geq 27$
36Cl	Chlorine (17)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
38Cl	Chlorine (17)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
242Cm	Curium (96)	$\leq 0.0002$	$\leq 0.2$	$> 0.2$	$\geq 600$
243Cm	Curium (96)	$\leq 0.009$ mCi	$\leq 0.009$	$> 0.009$	$\geq 27$
244Cm	Curium (96)	$\leq 0.010$ mCi	$\leq 0.01$	$> 0.01$	$\geq 30$
245Cm	Curium (96)	$\leq 0.006$ mCi	$\leq 0.006$	$> 0.006$	$\geq 18$
246Cm	Curium (96)	$\leq 0.006$ mCi	$\leq 0.006$	$> 0.006$	$\geq 18$
56Co	Cobalt (27)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15K$
57Co	Cobalt (27)	$\leq 0.09$	$\leq 90$	$> 90$	$\geq 30K$
58mCo	Cobalt (27)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
58Co	Cobalt (27)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
60Co	Cobalt (27)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21K$
51Cr	Chromium (24)	$\leq 0.6$	$\leq 600$	$> 600$	$\geq 30K$
129Cs	Cesium (55)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30K$
131Cs	Cesium (55)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
134mCs	Cesium (55)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_2$  value by 10,000.\*\*For shipments solely within the United States the  $A_2$  value is 20 Ci for americium and plutonium contained in Am-Be or Pu-Be neutron sources or in nuclear-powered pacemakers.

TABLE APP C-4 (Continued)

Normal Form Only  
Activity Limits for Radionuclides in Normal Form. (All values  
in curies (Ci) unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_2/1,000$ )	Type A qty ( $\leq A_2$ )	Type B qty ( $> A_2$ )	Highway Route controlled quantity ( $3,000 \times A_2$ or 30K)
$^{134}\text{Cs}$	Cesium (55)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{135}\text{Cs}$	Cesium (55)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{136}\text{Cs}$	Cesium (55)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{137}\text{Cs}$	Cesium (55)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{64}\text{Cu}$	Copper (29)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{67}\text{Cu}$	Copper (29)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{165}\text{Dy}$	Dysprosium (66)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{166}\text{Dy}$	Dysprosium (66)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{169}\text{Er}$	Erbium (68)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{171}\text{Er}$	Erbium (68)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{152}\text{Eu}$	Europium (63)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{152}\text{Eu}$	Europium (63)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{154}\text{Eu}$	Europium (63)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{155}\text{Eu}$	Europium (63)	$\leq 0.05$	$\leq 50$	$> 50$	$\geq 30\text{K}$
$^{18}\text{F}$	Fluorine (9)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{52}\text{Fe}$	Iron (26)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{59}\text{Fe}$	Iron (26)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{59}\text{Fe}$	Iron (26)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{67}\text{Ga}$	Gallium (31)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{68}\text{Ga}$	Gallium (31)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{72}\text{Ga}$	Gallium (31)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{153}\text{Gd}$	Gadolinium (64)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{159}\text{Gd}$	Gadolinium (64)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{68}\text{Ge}$	Germanium (32)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{71}\text{Ge}$	Germanium (32)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^3\text{H}$	Hydrogen (1)	$\dagger$	$\dagger$	$\dagger$	$\dagger$
$^{181}\text{Hf}$	Hafnium (72)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{197}\text{mHg}$	Mercury (80)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{197}\text{Hg}$	Mercury (80)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{203}\text{Hg}$	Mercury (80)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{166}\text{Ho}$	Holmium (67)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{123}\text{I}$	Iodine (53)	$\leq 0.05$	$\leq 50$	$> 50$	$\geq 30\text{K}$
$^{125}\text{I}$	Iodine (53)	$\leq 0.07$	$\leq 70$	$> 70$	$\geq 30\text{K}$
$^{126}\text{I}$	Iodine (53)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{129}\text{I}$	Iodine (53)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6\text{K}$
$^{131}\text{I}$	Iodine (53)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{132}\text{I}$	Iodine (53)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{133}\text{I}$	Iodine (53)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{134}\text{I}$	Iodine (53)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 24\text{K}$
$^{135}\text{I}$	Iodine (53)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{111}\text{In}$	Indium (49)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{113\text{m}}\text{In}$	Indium (49)	$\leq 0.05$	$\leq 50$	$> 50$	$\geq 30\text{K}$
$^{114\text{m}}\text{In}$	Indium (49)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{115\text{m}}\text{In}$	Indium (49)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{190}\text{Ir}$	Iridium (77)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{192}\text{Ir}$	Iridium (77)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{194}\text{Ir}$	Iridium (77)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{42}\text{K}$	Potassium (19)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{43}\text{K}$	Potassium (19)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{85\text{m}}\text{Kr}$ (Uncomp)	Krypton (36)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{85\text{m}}\text{Kr}$ (Comp)	Krypton (36)	$\leq 0.003$	$\leq 3$	$> 3$	$\geq 9\text{K}$
$^{85}\text{Kr}$ (Uncomp)	Krypton (36)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{85}\text{Kr}$ (Comp)	Krypton (36)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$
$^{87}\text{Kr}$ (Uncomp)	Krypton (36)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{87}\text{Kr}$ (Comp)	Krypton (36)	$\leq 0.0005$	$\leq 0.5$	$> 0.5$	$\geq 1,800$
$^{140}\text{La}$	Lanthanum (57)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
LSA (Low Specific Activity)	See 173.403 (n)				
$^{177}\text{Lu}$	Lutetium (71)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
MFP	Mixed fission products	$\leq 0.0004$	$\leq 0.4$	$> 0.4$	$\geq 1,200$
$^{28}\text{Mg}$	Magnesium (12)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15\text{K}$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_2$  value by 10,000. $\dagger$ See tritium.

TABLE APP C-4 (Continued)

Normal Form Only  
Activity Limits for Radionuclides in Normal Form. (All values  
in curies [Ci] unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_2/1,000$ )	Type A qty ( $\leq A_2$ )	Type B qty ( $> A_2$ )	Highway Route controlled quantity ( $3,000 \times A_2$ or 30K)
<sup>52</sup> Mn	Manganese (25)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15K$
<sup>54</sup> Mn	Manganese (25)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>56</sup> Mn	Manganese (25)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15K$
<sup>89</sup> Mo	Molybdenum (42)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>13</sup> N	Nitrogen (7)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
<sup>22</sup> Na	Sodium (11)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 24K$
<sup>24</sup> Na	Sodium (11)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15K$
<sup>93m</sup> Nb	Niobium (41)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
<sup>95</sup> Nb	Niobium (41)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>97</sup> Nb	Niobium (41)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>147</sup> Nd	Neodymium (60)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>149</sup> Nd	Neodymium (60)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>59</sup> Ni	Nickel (28)	$\leq 0.9$	$\leq 900$	$> 900$	$\geq 30K$
<sup>63</sup> Ni	Nickel (28)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30K$
<sup>65</sup> Ni	Nickel (28)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
<sup>237</sup> Np	Neptunium (93)	$\leq 0.005$ mCi	$\leq 0.005$	$> 0.005$	$\geq 15$
<sup>239</sup> Np	Neptunium (93)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
<sup>185</sup> Os	Osmium (76)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>191</sup> Os	Osmium (76)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
<sup>191m</sup> Os	Osmium (76)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
<sup>183</sup> Os	Osmium (76)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>32</sup> P	Phosphorus (15)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
<sup>230</sup> Pa	Protactinium (91)	$\leq 0.0008$	$\leq 0.8$	$> 0.8$	$\geq 2,400$
<sup>231</sup> Pa	Protactinium (91)	$\leq 0.002$ mCi	$\leq 0.002$	$> 0.002$	$\geq 6$
<sup>233</sup> Pa	Protactinium (91)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30K$
<sup>201</sup> Pb	Lead (82)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>210</sup> Pb	Lead (82)	$\leq 0.0002$	$\leq 0.2$	$> 0.2$	$\geq 600$
<sup>212</sup> Pb	Lead (82)	$\leq 0.005$	$\leq 5$	$> 5$	$\geq 15K$
<sup>103</sup> Pd	Palladium (46)	$\leq 0.7$	$\leq 700$	$> 700$	$\geq 30K$
<sup>109</sup> Pd	Palladium (46)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>147</sup> Pm	Promethium (61)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
<sup>149</sup> Pm	Promethium (61)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>210</sup> Po	Polonium (84)	$\leq 0.0002$	$\leq 0.2$	$> 0.2$	$\geq 600$
<sup>142</sup> Pr	Praseodymium (59)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
<sup>143</sup> Pr	Praseodymium (59)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>191</sup> Pt	Platinum (78)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30K$
<sup>193m</sup> Pt	Platinum (78)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
<sup>197m</sup> Pt	Platinum (78)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>197</sup> Pt	Platinum (78)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>238</sup> Pu**	Plutonium (94)	$\leq 0.003$ mCi	$\leq 0.003$	$> 0.003$	$\geq 9$
<sup>239</sup> Pu	Plutonium (94)	$\leq 0.002$ mCi	$\leq 0.002$	$> 0.002$	$\geq 6$
<sup>240</sup> Pu	Plutonium (94)	$\leq 0.002$ mCi	$\leq 0.002$	$> 0.002$	$\geq 6$
<sup>241</sup> Pu	Plutonium (94)	$\leq 0.0001$	$\leq 0.1$	$> 0.1$	$\geq 300$
<sup>242</sup> Pu	Plutonium (94)	$\leq 0.003$ mCi	$\leq 0.003$	$> 0.003$	$\geq 9$
<sup>223</sup> Ra	Radium (88)	$\leq 0.0002$	$\leq 0.2$	$> 0.2$	$\geq 600$
<sup>224</sup> Ra	Radium (88)	$\leq 0.005$	$\leq 0.5$	$> 0.5$	$\geq 1,500$
<sup>226</sup> Ra	Radium (88)	$\leq 0.05$ mCi	$\leq 0.05$	$> 0.05$	$\geq 150$
<sup>228</sup> Ra	Radium (88)	$\leq 0.05$ mCi	$\leq 0.05$	$> 0.05$	$\geq 150$
<sup>81</sup> Rb	Rubidium (37)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
<sup>86</sup> Rb	Rubidium (37)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
<sup>87</sup> Rb	Rubidium (37)	UL††	UL††	UL††	$\geq 30K$
Rb (Net)	Rubidium (37)	UL††	UL††	UL††	$\geq 30K$
<sup>186</sup> Re	Rhenium (75)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
<sup>187</sup> Re	Rhenium (75)	UL††	UL††	UL††	$\geq 30K$
<sup>188</sup> Re	Rhenium (75)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
Re (Net)	Rhenium (75)	UL††	UL††	UL††	$\geq 30K$
<sup>103m</sup> Rh	Rhodium (45)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
<sup>105</sup> Rh	Rhodium (45)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
<sup>222</sup> Rn	Radon (86)	$\leq 0.02$	$\leq 2$	$> 2$	$\geq 6K$
<sup>97</sup> Ru	Ruthenium (44)	$\leq 0.05$	$\leq 50$	$> 50$	$\geq 30K$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_2$  value by 10,000.\*\*For shipments solely within the United States the  $A_2$  value is 20 Ci for americium and plutonium contained in Am-Be or Pu-Be neutron sources or in nuclear-powered pacemakers.

††Unlimited.

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Normal Form Only  
Activity Limits for Radionuclides in Normal Form. (All values  
in curies (Ci) unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_2/1,000$ )	Type A qty ( $\leq A_2$ )	Type B qty ( $> A_2$ )	Highway Route controlled quantity ( $3,000 \times A_2$ or 30K)
$^{103}\text{Ru}$	Ruthenium (44)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{105}\text{Ru}$	Ruthenium (44)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{106}\text{Ru}$	Ruthenium (44)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{35}\text{S}$	Sulfur (16)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{122}\text{Sb}$	Antimony (51)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{124}\text{Sb}$	Antimony (51)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15\text{K}$
$^{125}\text{Sb}$	Antimony (51)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{46}\text{Sc}$	Scandium (21)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 24\text{K}$
$^{47}\text{Sc}$	Scandium (21)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{48}\text{Sc}$	Scandium (21)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15\text{K}$
$^{76}\text{Se}$	Selenium (34)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{31}\text{Si}$	Silicon (14)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{147}\text{Sm}$	Samarium (62)	UL††	UL††	UL††	$\geq 30\text{K}$
$^{151}\text{Sm}$	Samarium (62)	$\leq 0.09$	$\leq 90$	$> 90$	$\geq 30\text{K}$
$^{153}\text{Sm}$	Samarium (62)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{113}\text{Sn}$	Tin (50)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{119\text{m}}\text{Sn}$	Tin (50)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{125}\text{Sn}$	Tin (50)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{86\text{m}}\text{Sr}$	Strontium (38)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30\text{K}$
$^{86}\text{Sr}$	Strontium (38)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30\text{K}$
$^{87\text{m}}\text{Sr}$	Strontium (38)	$\leq 0.05$	$\leq 50$	$> 50$	$\geq 30\text{K}$
$^{89}\text{Sr}$	Strontium (38)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{90}\text{Sr}$	Strontium (38)	$\leq 0.0004$	$\leq 0.4$	$> 0.4$	$\geq 1,200$
$^{91}\text{Sr}$	Strontium (38)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{92}\text{Sr}$	Strontium (38)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
T (Uncomp)	Tritium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Comp)	Tritium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Activated luminous paint)	Tritium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Adsorbed on solid)	Tritium (1)	$\leq 20$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (Tritiated water)	Tritium (1)	$< 0.1$ Ci/liter 0.1-1.0 Ci/liter $> 1.0$ Ci/liter	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
T (other forms)	Tritium (1)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{162}\text{Ta}$	Tantalum (73)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{160}\text{Tb}$	Terbium (65)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{96\text{m}}\text{Tc}$	Technetium (43)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{96}\text{Tc}$	Technetium (43)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18\text{K}$
$^{97\text{m}}\text{Tc}$	Technetium (43)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{97}\text{Tc}$	Technetium (43)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30\text{K}$
$^{98\text{m}}\text{Tc}$	Technetium (43)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{98}\text{Tc}$	Technetium (43)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{126\text{m}}\text{Te}$	Tellurium (52)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30\text{K}$
$^{127\text{m}}\text{Te}$	Tellurium (52)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{127}\text{Te}$	Tellurium (52)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{129\text{m}}\text{Te}$	Tellurium (52)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{129}\text{Te}$	Tellurium (52)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{131\text{m}}\text{Te}$	Tellurium (52)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
$^{132}\text{Te}$	Tellurium (52)	$\leq 0.007$	$\leq 7$	$> 7$	$\geq 21\text{K}$
$^{227}\text{Th}$	Thorium (90)	$\leq 0.0002$	$\leq 0.2$	$> 0.2$	$\geq 600$
$^{228}\text{Th}$	Thorium (90)	$\leq 0.006$ mCi	$\leq 0.006$	$> 0.006$	$\geq 24$
$^{230}\text{Th}$	Thorium (90)	$\leq 0.003$ mCi	$\leq 0.003$	$> 0.003$	$\geq 9$
$^{231}\text{Th}$	Thorium (90)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30\text{K}$
$^{232}\text{Th}$	Thorium (90)	UL††	UL††	UL††	$\geq 30\text{K}$
$^{234}\text{Th}$	Thorium (90)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$
Th (Net)	Thorium (90)	UL††	UL††	UL††	$\geq 30\text{K}$
Th (Irrad)	Thorium (90)	†	†	†	$\geq 30\text{K}$
$^{200}\text{Tl}$	Thallium (81)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30\text{K}$
$^{201}\text{Tl}$	Thallium (81)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30\text{K}$
$^{202}\text{Tl}$	Thallium (81)	$\leq 0.04$	$\leq 40$	$> 40$	$\geq 30\text{K}$
$^{204}\text{Tl}$	Thallium (81)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30\text{K}$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_2$  value by 10,000.

††Unlimited

‡The values of  $A_1$  and  $A_2$  must be calculated in accordance with the procedure specified in 49CFR173.433, taking into account the activity of the fission products and of the uranium-233 in addition to that of the thorium.

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in curies [Ci] unless otherwise stated.) (Continued)

Radionuclide symbol	Element & atomic number	Limited qty* ( $\leq A_2/1,000$ )	Type A qty ( $\leq A_2$ )	Type B qty ( $> A_2$ )	Highway Route controlled quantity ( $3,000 \times A_2$ or 30K)
170Tm	Thulium (69)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
171Tm	Thulium (69)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
230U	Uranium (92)	$\leq 0.0001$	$\leq 0.1$	$> 0.1$	$\geq 300$
232U	Uranium (92)	$\leq 0.03$ mCi	$\leq 0.03$	$> 0.03$	$\geq 90$
233U	Uranium (92)	$\leq 0.0001$	$\leq 0.1$	$> 0.1$	$\geq 300$
234U	Uranium (92)	$\leq 0.0001$	$\leq 0.1$	$> 0.1$	$\geq 300$
235U	Uranium (92)	$\leq 0.0002$	$\leq 0.2$	$> 0.2$	$\geq 600$
236U	Uranium (92)	$\leq 0.0002$	$\leq 0.2$	$> 0.2$	$\geq 600$
238U	Uranium (92)	UL††	UL††	UL††	$\geq 30K$
U (Net)	Uranium (92)	UL††	UL††	UL††	$\geq 30K$
U (Enr<20%)	Uranium (92)	UL††	UL††	UL††	$\geq 30K$
U (Enr>20%)	Uranium (92)	$\leq 0.0001$	$\leq 0.1$	$> 0.1$	$\geq 300$
U (Depl)	Uranium (92)	UL††	UL††	UL††	$\geq 30K$
U (irrad)	††	††	††	††	$\geq 30K$
48V	Vanadium (23)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 18K$
181W	Tungsten (74)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
185W	Tungsten (74)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
187W	Tungsten (74)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
127Xe (Uncomp)	Xenon (54)	$\leq 0.07$	$\leq 70$	$> 70$	$\geq 30K$
127Xe (Comp)	Xenon (54)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15K$
131mXe (Comp)	Xenon (54)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
131mXe (Uncomp)	Xenon (54)	$\leq 0.1$	$\leq 100$	$> 100$	$\geq 30K$
133Xe (Uncomp)	Xenon (54)	$\leq 1.0$	$\leq 1,000$	$> 1,000$	$\geq 30K$
133Xe (Comp)	Xenon (54)	$\leq 0.006$	$\leq 6$	$> 6$	$\geq 15K$
135Xe (Uncomp)	Xenon (54)	$\leq 0.07$	$\leq 70$	$> 70$	$\geq 30K$
135Xe (Comp)	Xenon (54)	$\leq 0.002$	$\leq 2$	$> 2$	$\geq 6K$
87Y	Yttrium (39)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
90Y	Yttrium (39)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
91mY	Yttrium (39)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
91Y	Yttrium (39)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
92Y	Yttrium (39)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
93Y	Yttrium (39)	$\leq 0.01$	$\leq 10$	$> 10$	$\geq 30K$
169Yb	Ytterbium (70)	$\leq 0.06$	$\leq 60$	$> 60$	$\geq 30K$
175Yb	Ytterbium (70)	$\leq 0.025$	$\leq 25$	$> 25$	$\geq 30K$
65Zn	Zinc (30)	$\leq 0.03$	$\leq 30$	$> 30$	$\geq 30K$
69mZn	Zinc (30)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
67Zn	Zinc (30)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
93Zr	Zirconium (40)	$\leq 0.2$	$\leq 200$	$> 200$	$\geq 30K$
95Zr	Zirconium (40)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$
97Zr	Zirconium (40)	$\leq 0.02$	$\leq 20$	$> 20$	$\geq 30K$

\*Values given for solids and gases only, for liquids divide value given by 10 or divide the  $A_2$  value by 10,000.

††Unlimited

††The values of  $A_1$  and  $A_2$  must be calculated in accordance with the procedure specified in 49CFR173.433, taking into account the activity of the fission products and of the plutonium isotopes in addition to that of the uranium.

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TABLE APP C-5

SPECIFIC ACTIVITY VALUES FOR RADIONUCLIDES

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TABLE APP C-5

## SPECIFIC ACTIVITY VALUES FOR RADIONUCLIDES

Element & Atomic No.	Radio- nuclide	Specific Activity* (Ci/g)	Element & Atomic No.	Radio- nuclide	Specific Activity (Ci/g)
Actinium (89)	<sup>227</sup> Ac	7.2 E+1	Beryllium (4)	<sup>7</sup> Be	3.5 E+5
Actinium	<sup>228</sup> Ac	2.2 E+6	Bismuth (85)	<sup>206</sup> Bi	9.9 E+4
Americium (95)	<sup>241</sup> Am	3.2	Bismuth	<sup>207</sup> Bi	2.2 E+2
Americium	<sup>243</sup> Am	1.9 E-1	Bismuth	<sup>210</sup> Bi	1.2 E+5
Antimony (51)	<sup>122</sup> Sb	3.9 E-5	Bismuth	<sup>212</sup> Bi	1.5 E+7
Antimony	<sup>124</sup> Sb	1.8 E+4	Bromine (35)	<sup>77</sup> Br	7.1 E+5
Antimony	<sup>125</sup> Sb	1.4 E+3	Bromine	<sup>82</sup> Br	1.1 E+6
Argon (18)	<sup>37</sup> Ar	1.0 E+5	Cadmium (48)	<sup>109</sup> Cd	2.6 E+3
Argon	<sup>41</sup> Ar**	4.3 E+7	Cadmium	<sup>115m</sup> Cd	2.6 E+4
Arsenic (33)	<sup>73</sup> As	2.4 E+4	Cadmium	<sup>115</sup> Cd	5.1 E+5
Arsenic	<sup>74</sup> As	1.0 E+5	Calcium (20)	<sup>45</sup> Ca	1.9 E+4
Arsenic	<sup>76</sup> As	1.6 E+6	Calcium	<sup>47</sup> Ca	5.9 E+5
Arsenic	<sup>77</sup> As	1.1 E+6	Californium (98)	<sup>249</sup> Cf	3.1
Astatine (85)	<sup>211</sup> At	2.1 E+6	Californium	<sup>250</sup> Cf	1.3 E+2
Barium (56)	<sup>131</sup> Ba	8.7 E+4	Californium	<sup>252</sup> Cf	6.5 E+2
Barium	<sup>133</sup> Ba	4.0 E+2	Carbon (6)	<sup>11</sup> C	8.4 E+8
Barium	<sup>140</sup> Ba	7.3 E+4	Carbon	<sup>14</sup> C	4.6
Berkelium (97)	<sup>249</sup> Bk	1.8 E+3	Cerium (58)	<sup>139</sup> Ce	6.5 E+3

\*The notation E+4 means  $\times 10^4$ ; E-4 means  $\times 10^{-4}$ .

\*\*Uncompressed gas only.



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Element & Atomic No.	Radio- nuclide	Specific Activity (Ci/g)	Element & Atomic No.	Radio- nuclide	Specific Activity (Ci/g)
Cerium	<sup>141</sup> Ce	2.8 E+4	Curium	<sup>243</sup> Cm	4.2 E+1
Cerium	<sup>143</sup> Ce	6.6 E+5	Curium	<sup>244</sup> Cm	8.2 E+1
Cerium	<sup>144</sup> Ce	3.2 E+3	Curium	<sup>245</sup> Cm	1.0 E-1
Cesium (55)	<sup>129</sup> Cs	7.6 E+5	Curium	<sup>246</sup> Cm	3.6 E-1
Cesium	<sup>131</sup> Cs	1.0 E+5	Dysprosium (66)	<sup>165</sup> Dy	8.2 E+6
Cesium	<sup>134m</sup> Cs	7.4 E+6	Dysprosium	<sup>166</sup> Dy	2.3 E+5
Cesium	<sup>134</sup> Cs	1.2 E+3	Erbium (68)	<sup>169</sup> Er	8.2 E+4
Cesium	<sup>135</sup> Cs	8.8 E-4	Erbium	<sup>171</sup> Er	2.4 E+6
Cesium	<sup>136</sup> Cs	7.4 E+4	Europium (63)	<sup>152m</sup> Eu	2.2 E+6
Cesium	<sup>137</sup> Cs	9.8 E+1	Europium	<sup>152</sup> Eu	1.9 E+2
Chlorine (17)	<sup>36</sup> Cl	3.2 E-2	Europium	<sup>154</sup> Eu	1.5 E+2
Chlorine	<sup>38</sup> Cl	1.3 E+8	Europium	<sup>155</sup> Eu	1.4 E+3
Chromium (24)	<sup>51</sup> Cr	9.2 E+4	Fluorine (9)	<sup>18</sup> F	9.3 E+7
Cobalt (27)	<sup>56</sup> Co	3.0 E+4	Gadolinium (64)	<sup>153</sup> Gd	3.6 E+3
Cobalt	<sup>57</sup> Co	8.5 E+3	Gadolinium	<sup>159</sup> Gd	1.1 E+6
Cobalt	<sup>58m</sup> Co	5.9 E+6	Gallium (31)	<sup>67</sup> Ga	6.0 E+5
Cobalt	<sup>58</sup> Co	3.1 E+4	Gallium	<sup>68</sup> Ga	4.0 E+7
Cobalt	<sup>60</sup> Co	1.1 E+3	Gallium	<sup>72</sup> Ga	3.1 E+6
	<sup>64</sup>			<sup>68</sup>	

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<u>Element &amp; Atomic No.</u>	<u>Radio- nuclide</u>	<u>Specific Activity (Ci/g)</u>	<u>Element &amp; Atomic No.</u>	<u>Radio- nuclide</u>	<u>Specific Activity (Ci/g)</u>
Gold	<sup>196</sup> Au	1.2 E+5	Iron (26)	<sup>52</sup> Fe	7.3 E+6
Gold	<sup>198</sup> Au	2.5 E+5	Iron	<sup>55</sup> Fe	2.2 E+3
Gold	<sup>199</sup> Au	2.1 E+5	Iron	<sup>59</sup> Fe	4.9 E+4
Hafnium (72)	<sup>181</sup> Hf	1.6 E+4	Krypton (36)	<sup>85m</sup> Kr	8.4 E+6
Holmium (67)	<sup>166</sup> Ho	6.9 E+5	Krypton	<sup>85</sup> Kr	4.0 E+2
Iodine (53)	<sup>123</sup> I	1.9 E+6	Krypton	<sup>87</sup> Kr	2.8 E+7
Iodine	<sup>125</sup> I	1.7 E+4	Lanthanum (57)	<sup>140</sup> La	5.6 E+5
Iodine	<sup>126</sup> I	7.8 E+4	Lead (82)	<sup>210</sup> Pb	8.8 E+1
Iodine	<sup>129</sup> I	1.6 E-4	Lead	<sup>212</sup> Pb	1.4 E+6
Iodine	<sup>131</sup> I	1.2 E+5	Lutetium (71)	<sup>177</sup> Lu	1.1 E+5
Iodine	<sup>132</sup> I	1.1 E+7	Magnesium (12)	<sup>28</sup> Mg	5.2 E+6
Iodine	<sup>133</sup> I	1.1 E+6	Manganese (25)	<sup>52</sup> Mn	4.4 E+5
Iodine	<sup>134</sup> I	2.7 E+7	Manganese	<sup>54</sup> Mn	8.3 E+3
Iodine	<sup>135</sup> I	3.5 E+6	Manganese	<sup>56</sup> Mn	2.2 E+7
Indium (49)	<sup>111</sup> In	4.2 E+5	Mercury (80)	<sup>197m</sup> Hg	6.6 E+5
Indium	<sup>113m</sup> In	1.6 E+7	Mercury	<sup>197</sup> Hg	2.5 E+5
Indium	<sup>114m</sup> In	2.3 E+4	Mercury	<sup>203</sup> Hg	1.4 E+4
Indium	<sup>115m</sup> In	6.1 E+6	Molybdenum (42)	<sup>99</sup> Mo	4.7 E+5
Iridium (77)	<sup>190</sup> Ir	6.2 E+4	Neodymium (60)	<sup>147</sup> Nd	8.0 E+4
Iridium	<sup>192</sup> Ir	9.1 E+3	Neodymium	<sup>149</sup> Nd	1.1 E+7
Iridium	<sup>194</sup> Ir	8.5 E+5	Neptunium (93)	<sup>237</sup> Np	6.9 E-4

TABLE APP C-5 (Continued)

<u>Element &amp; Atomic No.</u>	<u>Radio- nuclide</u>	<u>Specific Activity (Ci/g)</u>	<u>Element &amp; Atomic No.</u>	<u>Radio- nuclide</u>	<u>Specific Activity (Ci/g)</u>
Neptunium	<sup>239</sup> Np	2.3 E+5	Plutonium	<sup>239</sup> Pu	6.2 E-2
Nickel (28)	<sup>59</sup> Ni	8.1 E-2	Plutonium	<sup>240</sup> Pu	2.3 E-1
Nickel	<sup>63</sup> Ni	4.6 E+2	Plutonium	<sup>241</sup> Pu	1.1 E+2
Nickel	<sup>65</sup> Ni	1.9 E+7	Plutonium	<sup>242</sup> Pu	3.9 E-3
Niobium (41)	<sup>93m</sup> Nb	1.1 E+3	Polonium (84)	<sup>210</sup> Po	4.5 E+3
Niobium	<sup>95</sup> Nb	3.9 E+4	Potassium (19)	<sup>42</sup> K	6.0 E+6
Niobium	<sup>97</sup> Nb	2.6 E+7	Potassium	<sup>43</sup> K	3.3 E+6
Nitrogen (7)	<sup>13</sup> N	1.5 E+9	Praseodymium (59)	<sup>142</sup> Pr	1.2 E+6
Osmium (76)	<sup>185</sup> Os	7.3 E+3	Praseodymium	<sup>143</sup> Pr	6.6 E+4
Osmium	<sup>191</sup> Os	4.6 E+4	Promethium (61)	<sup>147</sup> Pd	9.4 E+2
Osmium	<sup>191m</sup> Os	1.2 E+6	Promethium	<sup>149</sup> Pd	4.2 E+5
Osmium	<sup>193</sup> Os	5.3 E+5	Protactinium (91)	<sup>230</sup> Pa	3.2 E+4
Palladium (46)	<sup>103</sup> Pd	7.5 E+4	Protactinium	<sup>231</sup> Pa	4.5 E-2
Palladium	<sup>109</sup> Pd	2.1 E+6	Protactinium	<sup>233</sup> Pa	2.1 E+4
Phosphorus (15)	<sup>32</sup> P	2.9 E+5	Radium (88)	<sup>223</sup> Ra	5.0 E+4
Platinum (78)	<sup>191</sup> Pt	2.3 E+5	Radium	<sup>224</sup> Ra	1.6 E+5
Platinum	<sup>193m</sup> Pt	2.0 E+5	Radium	<sup>226</sup> Ra	1.0
Platinum	<sup>197m</sup> Pt	1.2 E+7	Radium	<sup>228</sup> Ra	2.3 E+2
Platinum	<sup>197</sup> Pt	8.8 E+5	Radon (86)	<sup>222</sup> Rn	1.5 E+5
Plutonium (94)	<sup>238</sup> Pu	1.7 E+1	Rhenium (75)	<sup>186</sup> Re	1.9 E+5

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TABLE APP C-5 (Continued)

Element & Atomic No.	Radio- nuclide	Specific Activity (Ci/g)	Element & Atomic No.	Radio- nuclide	Specific Activity (Ci/g)
Rhenium	<sup>187</sup> Re	3.8 E-8	Silicon (14)	<sup>31</sup> Si	3.9 E+7
Rhenium	<sup>188</sup> Re	1.0 E+6	Silver (47)	<sup>105</sup> Ag	3.1 E+4
Rhenium	Re (natural)	2.4 E-8	Silver	<sup>110m</sup> Ag	4.7 E+3
Rhodium (45)	<sup>103m</sup> Rh	3.2 E+7	Silver	<sup>111</sup> Ag	1.6 E+5
Rhodium	<sup>105</sup> Rh	8.2 E+5	Sodium (11)	<sup>22</sup> Na	6.3 E+3
Rubidium (37)	<sup>81</sup> Rb	8.2 E+6	Sodium	<sup>24</sup> Na	8.7 E+6
Rubidium	<sup>86</sup> Rb	8.1 E+4	Strontium (38)	<sup>85m</sup> Sr	3.2 E+7
Rubidium	<sup>87</sup> Rb	6.6 E-8	Strontium	<sup>85</sup> Sr	2.4 E+4
Rubidium	Rb (natural)	1.8 E-8	Strontium	<sup>87m</sup> Sr	1.2 E+7
Ruthenium (44)	<sup>97</sup> Ru	5.5 E+5	Strontium	<sup>89</sup> Sr	2.9 E+4
Ruthenium	<sup>103</sup> Ru	3.2 E+4	Strontium	<sup>90</sup> Sr	1.5 E+2
Ruthenium	<sup>105</sup> Ru	6.6 E+6	Strontium	<sup>91</sup> Sr	3.6 E+6
Ruthenium	<sup>106</sup> Ru	3.4 E+3	Strontium	<sup>92</sup> Sr	1.3 E+7
Samarium (62)	<sup>147</sup> Sm	2.0 E-8	Sulphur (16)	<sup>35</sup> S	4.3 E+4
Samarium	<sup>151</sup> Sm	2.6 E+1	Tantalum (73)	<sup>182</sup> Ta	6.2 E+3
Samarium	<sup>153</sup> Sm	4.4 E+5	Technetium (43)	<sup>96m</sup> Tc	3.8 E+7
Scandium (21)	<sup>46</sup> Sc	3.4 E+4	Technetium	<sup>96</sup> Tc	3.2 E+5
Scandium	<sup>47</sup> Sc	8.2 E+5	Technetium	<sup>97m</sup> Tc	1.5 E+4
Scandium	<sup>48</sup> Sc	1.5 E+6	Technetium	<sup>97</sup> Tc	1.4 E-3
Selenium (34)	<sup>75</sup> Se	1.4 E+4	Technetium	<sup>99m</sup> Tc	5.2 E+6
			Technetium	<sup>99</sup> Tc	1.7 E-2

TABLE APP C-5 (Continued)

Element & Atomic No.	Radio- nuclide	Specific Activity (Ci/g)	Element & Atomic No.	Radio- nuclide	Specific Activity (Ci/g)
Tellurium (52)	$^{125m}\text{Te}$	1.8 E+4	Thulium	$^{171}\text{Tm}$	1.1 E+3
Tellurium	$^{127m}\text{Te}$	4.0 E+4	Tin (50)	$^{113}\text{Sn}$	1.0 E+4
Tellurium	$^{127}\text{Te}$	2.6 E+6	Tin	$^{125}\text{Sn}$	1.1 E+5
Tellurium	$^{129m}\text{Te}$	2.5 E+4	Tritium (1)	$^3\text{H}$	9.7 E+3
Tellurium	$^{129}\text{Te}$	2.0 E+7	Tungsten (74)	$^{181}\text{W}$	5.0 E+3
Tellurium	$^{131m}\text{Te}$	8.0 E+5	Tungsten	$^{185}\text{W}$	9.7 E-3
Tellurium	$^{132}\text{Te}$	3.1 E+5	Tungsten	$^{187}\text{W}$	7.0 E+5
Terbium (65)	$^{160}\text{Tb}$	1.1 E+4	Uranium (92)	$^{230}\text{U}$	2.7 E+4
Thallium (81)	$^{200}\text{Tl}$	5.8 E+5	Uranium	$^{231}\text{U}$	2.1 E+1
Thallium	$^{201}\text{Tl}$	2.2 E+5	Uranium	$^{233}\text{U}$	9.5 E-3
Thallium	$^{202}\text{Tl}$	5.4 E+4	Uranium	$^{234}\text{U}$	6.2 E-3
Thallium	$^{204}\text{Tl}$	4.3 E+2	Uranium	$^{235}\text{U}$	2.1 E-6
Thorium (90)	$^{227}\text{Th}$	3.2 E+4	Uranium	$^{236}\text{U}$	6.3 E-5
Thorium	$^{228}\text{Th}$	8.3 E+2	Uranium	$^{238}\text{U}$	3.3 E-7
Thorium	$^{230}\text{Th}$	1.9 E-2	Uranium (enr)	U	See Table A-4
Thorium	$^{231}\text{Th}$	5.3 E+5	Vanadium (23)	$^{48}\text{V}$	1.7 E+5
Thorium	$^{232}\text{Th}$	1.1 E-7	Xenon (54)	$^{127}\text{Xe}$	2.8 E+4
Thorium	$^{234}\text{Th}$	2.3 E+4	Xenon	$^{131m}\text{Xe}$	1.0 E+5
Thorium	Th (natural)	2.2 E-7	Xenon	$^{133}\text{Xe}$	1.9 E+5
Thulium (69)	$^{170}\text{Tm}$	6.0 E+3	Xenon	$^{135}\text{Xe}$	2.5 E+5

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## RADIOACTIVE MATERIAL CHARACTERIZATION

TABLE APP C-5 (Continued)

<u>Element &amp; Atomic No.</u>	<u>Radio- nuclide</u>	<u>Specific Activity (Ci/g)</u>
Ytterbium (70)	$^{169}\text{Yb}$	2.3 E+5
Ytterbium	$^{175}\text{Yb}$	1.8 E+5
Yttrium (39)	$^{87}\text{Y}$	4.5 E+1
Yttrium	$^{90}\text{Y}$	2.5 E+5
Yttrium	$^{91\text{m}}\text{Y}$	4.1 E+7
Yttrium	$^{91}\text{Y}$	2.5 E+4
Yttrium	$^{92}\text{Y}$	9.5 E+6
Yttrium	$^{93}\text{Y}$	3.2 E+6
Zinc (30)	$^{65}\text{Zn}$	8.0 E+3
Zinc	$^{69\text{m}}\text{Zn}$	3.3 E+6
Zinc	$^{69}\text{Zn}$	5.3 E+7
Zirconium (40)	$^{93}\text{Zr}$	3.5 E-3
Zirconium	$^{95}\text{Zr}$	2.1 E+4
Zirconium	$^{97}\text{Zr}$	2.0 E+6

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TABLE APP C-6

ACTIVITY-MASS RELATIONSHIPS FOR URANIUM  
(DEPLETED, NATURAL AND ENRICHED)

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TABLE APP C-6

## ACTIVITY-MASS RELATIONSHIPS FOR URANIUM

<sup>235</sup> U* Enrichment (wt% Present)	Specific Activity** (Ci/g)	(g/Ci)
0.0	3.3 E-7	3.0 E+6
0.45	5.0 E-7	2.0 E+6
0.72 (natural)	7.06 E-7	1.42 E+6
1.0	7.6 E-7	1.3 E+6
1.5	1.0 E-6	1.0 E+6
5.0	2.7 E-6	3.7 E+5
10.0	4.8 E-6	2.1 E+5
20.0	1.0 E-5	1.0 E+5
35.0	2.0 E-5	5.0 E+4
50.0	2.5 E-5	4.0 E+4
90.0	5.8 E-5	1.7 E+4
93.0	7.0 E-5	1.4 E+4
95.0	9.1 E-5	1.1 E+4

\*Figures for uranium include the activity of uranium-234,  
which is concentrated during the enrichment process.

\*\*The notation E-7 means  $\times 10^{-7}$ ; E+5 means  $\times 10^5$ .



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Organization Procurement and  
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HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

TITLE:

Approved by

PRENOTIFICATION REQUIREMENTS FOR  
OFFSITE SHIPMENTS OF SPENT FUEL  
AND HIGH LEVEL RADIOACTIVE WASTE

  
D. K. Quigley, Manager,  
Procurement and Materials Mgmt

## 1.0 PURPOSE

The purpose of this procedure is to provide guidance for the rules to be followed in making prenotification of unclassified spent fuel and high level waste shipments offsite per the Department of Energy (DOE) directive and dated August 1, 1987.

## 2.0 SCOPE

This procedure establishes requirements to be followed by each facility originating unclassified spent fuel or high level radioactive waste shipments which are destined for transport and delivery outside the Hanford Site boundaries.

## 3.0 GUIDANCE AND REQUIREMENTS

3.1 The manager of a facility or his delegate, who intends to ship either unclassified spent fuel or high level radioactive waste outside the Hanford Site must, in cooperation with Traffic, make the following notifications:

### 3.1.1 For Unclassified Spent Fuel:

3.1.1.1 Prenotification: At least two weeks prior to the scheduled shipment departure date, the following information must be submitted to Traffic for concurrence and subsequent transmittal to DOE-Richland (DOE-RL).

NOTE: Traffic will provide items c. and e., and all carrier data.

- a. The name, address, and telephone number of the shipper and receiver.
- b. A description of the shipment as specified by the Department of Transportation in 49 CFR 172.202 and 172.203(d).
- c. A listing of the routes to be used within each State.
- d. The estimated date and time of departure from the point of origin of the shipment.

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- e. The estimated date and time of entry into each Governor's State.
- f. A request that the information be protected against disclosure.

A form for data submittal (Attachment A) can be obtained from Traffic.

3.1.1.2 Schedule Change Notice: Any schedule change which differs by more than six hours from the scheduled information previously furnished must be reported by telephone or other means using the same communication channels.

3.1.1.3 Cancellation Notice: Any cancellation must be reported by telephone or other means using established communication channels. A record of how the cancellation was transmitted shall be retained for one year.

3.1.2 For Unclassified High Level Radioactive Waste:

3.1.2.1 Prenotification: At least two weeks prior to the scheduled shipment departure date, the following information must be submitted to Traffic for concurrence and subsequent transmittal to DOE-RL.

NOTE: Traffic will provide items d. and f. and all carrier data.

- a. The name, address, and telephone number of the shipper receiver.
- b. The address of the point of origin of the shipment and a 7-day period during which departure of the shipment is estimated to occur.
- c. A description of the waste shipment as specified by the Department of Transportation in 49 CFR 172.202 and 172.203(d).
- d. A 7-day period during which arrival of the shipment at each State boundary is estimated to occur.
- e. The destination of the shipment and the 7-day period during which arrival of the shipment is estimated to occur.
- f. A point of contact with a telephone number for current shipment information.
- g. A request that the information be protected against disclosure.

A form for submittal of this information (Attachment B) can be obtained from Traffic.

3.1.2.2 Schedule Change Notice: Any scheduled change which would result in a departure from the originally submitted plan would require notification by telephone or other means using the same communication channels.

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3.1.2.3 Cancellation Notice: Any cancellation must be reported by telephone or other means using established communication channels. A record of how the cancellation was transmitted shall be retained for one year.

3.2 Traffic will review the submittal form for accuracy, completeness, regulatory compliance and provide a concurring signature. Traffic will also complete routing information and identify estimated time of arrival into each State enroute. Each submittal will be logged in and transmitted to the identified DOE-RL contact on or before the next normally scheduled work day.

3.3 Traffic will transmit all schedule changes and cancellations via telephone to the identified DOE-RL contacts. A logged record of the telephone communication will be retained for one year.

3.4 Traffic will schedule carriers and equipment for each shipment and will establish carrier procedures for notification if delays are incurred during transport.

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ATTACHMENT A

UNCLASSIFIED SPENT FUEL SHIPMENT  
PRENOTIFICATION STATEMENT

SHIPMENT  
NUMBER  
DOE

SHIPPER (Origin Point)

Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Phone: \_\_\_\_\_

CARRIER (Completed by Traffic)

Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Phone: \_\_\_\_\_

RECEIVER (Destination)

Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Phone: \_\_\_\_\_

SHIPMENT DESCRIPTION

DOT Proper Shipping Name: \_\_\_\_\_  
Hazard Class: \_\_\_\_\_  
ID# & Secondary Hazards: \_\_\_\_\_  
Quantity (MT): \_\_\_\_\_  
Radionuclides: \_\_\_\_\_  
Physical Form: \_\_\_\_\_  
Chemical Form: \_\_\_\_\_  
Activity (Ci): \_\_\_\_\_  
Labels (W-I, Y-II, Y-III): \_\_\_\_\_  
T.I.: \_\_\_\_\_  
Fissile Class (I, II, III): \_\_\_\_\_  
Container ID (COC #): \_\_\_\_\_  
Miscellaneous: \_\_\_\_\_

SCHEDULED DEPARTURE

Date: \_\_\_\_\_ Time: \_\_\_\_\_

ROUTING INFORMATION (Completed by Traffic)

State A Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Date: \_\_\_\_\_ Time: \_\_\_\_\_  
State B Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Date: \_\_\_\_\_ Time: \_\_\_\_\_  
State C Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Date: \_\_\_\_\_ Time: \_\_\_\_\_  
State D Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Date: \_\_\_\_\_ Time: \_\_\_\_\_

APPROVALS

Originator Approval

Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Print Name: \_\_\_\_\_

Traffic Department Concurrence

Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Print Name: \_\_\_\_\_

POINT OF CONTACT

Department of Energy

Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Print Name: \_\_\_\_\_ Phone: \_\_\_\_\_

NOTE: THIS INFORMATION HEREIN MUST BE PROTECTED AGAINST UNAUTHORIZED DISCLOSURE.

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HAZARDOUS MATERIAL PACKAGING  
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ATTACHMENT B

UNCLASSIFIED HIGH LEVEL RADIOACTIVE WASTE SHIPMENT  
PRENOTIFICATION STATEMENT

SHIPMENT  
NUMBER  
DOE

SHIPPER (Origin Point)

Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_

CARRIER (Completed by Traffic)

Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_

RECEIVER (Destination)

Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Phone: \_\_\_\_\_

Phone: \_\_\_\_\_

SHIPMENT DESCRIPTION

DOT Proper Shipping Name: \_\_\_\_\_  
Hazard Class: \_\_\_\_\_  
ID# & Secondary Hazards: \_\_\_\_\_  
Quantity (MT): \_\_\_\_\_  
Radionuclides: \_\_\_\_\_  
Physical Form: \_\_\_\_\_  
Chemical Form: \_\_\_\_\_  
Activity (Ci): \_\_\_\_\_  
Labels (W-I, Y-II, Y-III): \_\_\_\_\_  
T.I.: \_\_\_\_\_  
Fissile Class (I, II, III): \_\_\_\_\_  
Container ID (COC #): \_\_\_\_\_  
Miscellaneous: \_\_\_\_\_

SCHEDULED DEPARTURE Dates: \_\_\_\_\_ To: \_\_\_\_\_ Time: \_\_\_\_\_

ROUTING INFORMATION (Completed by Traffic)

State A Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Dates: \_\_\_\_\_ To: \_\_\_\_\_ Time: \_\_\_\_\_  
State B Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Dates: \_\_\_\_\_ To: \_\_\_\_\_ Time: \_\_\_\_\_  
State C Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Dates: \_\_\_\_\_ To: \_\_\_\_\_ Time: \_\_\_\_\_  
State D Name: \_\_\_\_\_  
Route: \_\_\_\_\_  
ETA Dates: \_\_\_\_\_ To: \_\_\_\_\_ Time: \_\_\_\_\_

APPROVALS

Originator Approval  
Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Print Name: \_\_\_\_\_  
Traffic Department Concurrence  
Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Print Name: \_\_\_\_\_

POINT OF CONTACT

Department of Energy  
Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Print Name: \_\_\_\_\_ Phone: \_\_\_\_\_

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Procurement and  
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HAZARDOUS MATERIAL PACKAGING  
AND SHIPPING

Effective Date  
Organization

TITLE:

Approved by

PRENOTIFICATION REQUIREMENTS FOR OFFSITE  
SHIPMENTS OF HIGHWAY ROUTE CONTROLLED  
QUANTITIES OF RADIOACTIVE MATERIALS

*D. K. Quigley*  
D. K. Quigley, Manager  
Procurement and Materials Mgmt

## 1.0 PURPOSE

The purpose of this procedure is to provide guidance in the U.S. Department of Energy (DOE) prenotification requirements related to the offsite shipments of Highway Route Controlled Quantities of radioactive materials. The requirements stated here are a result of a DOE directive dated May 8, 1985.

## 2.0 SCOPE

This procedure establishes requirements to be followed by each facility originating Highway Route Controlled Quantities of radioactive material shipments to offsite destinations.

## 3.0 GUIDANCE AND REQUIREMENTS

3.1 The manager or designate of a facility who arranges for the offsite shipment of a Highway Route Controlled Quantity of radioactive materials must provide to Traffic, 60 days prior to first shipment, the following data which will be forwarded to the DOE in a timely manner:

- o Materials to be shipped
- o Expected dates for the first and last shipment
- o Estimated number of shipments
- o Package or cask to be used
- o Destination of receiving facility
- o Security arrangements (when required).

3.2 Traffic will provide the following additional information:

- o Mode of transport
- o Probable carriers
- o Probable route to destination

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PRENOTIFICATION REQUIREMENTS FOR OFFSITE  
SHIPMENTS OF HIGHWAY ROUTE CONTROLLED  
QUANTITIES OF RADIOACTIVE MATERIALS

  
D. K. Quigley, Manager,  
Procurement and Materials Mgmt

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3.3 Should any of the above data be classified, then submission of data must be in complete compliance with applicable Safeguards and Security Directives and Orders.

NOTE: Notification concerning continuing campaigns, such as the Westinghouse continuing movements of irradiated materials to Idaho and New Mexico, are not required. Notifications concerning the shipments made via the Albuquerque Operations Office Transportation Safeguards Division are also exempt from this requirement.

3.4 Guidance regarding prenotification requirements for spent fuel and other radioactive waste is provided in Appendix I-1, "Prenotification Requirements for Spent Fuel and High Level Radioactive Waste Shipments."

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## 1.0 PURPOSE

This plan implements the elements of the Quality Assurance (QA) Program for all activities associated with the design, procurement, fabrication, and inspection verification of reusable radioactive materials packaging. This program conforms to the eighteen Quality Assurance Requirements of the Consensus Standard ANSI/ASME NQA-1-1986 as endorsed by the U.S. Department of Energy (DOE) in Orders.

## 2.0 SCOPE

The scope of this plan extends to operations performed on and off the Hanford Site under the jurisdictional authority of the Westinghouse Hanford Company (WHC).

## 3.0 GENERAL REQUIREMENTS

Existing packaging that has been approved for use shall continue to be acceptable for use under this plan provided they are subjected to the inspections, modification control, and handling requirements specified by this plan.

This plan addresses the requirements of WHC-CM-4-2, Quality Assurance Manual, the 18 elements of 10CFR71, Subpart H, and the QA requirements of DOE Order 5480.3 as they pertain to WHC activities. The following paragraphs identify the requirements for Radioactive Material Packaging (RAMPAK) and implement the QA requirements of 49CFR173 and 178. A standards and procedures matrix (QA Program Index) for RAMPAK is shown in Table 1 for ready reference to the requirements and implementing procedures.

### 1. ORGANIZATION

The WHC Quality Assurance Function is responsible for establishing an appropriate QA program and for assessing the effectiveness of the program to provide product and service quality. WHC-CM-1-3, Management Requirements and Procedures, MRP 5.2, "Quality Assurance," establishes policies, organizational requirements, responsibilities, and authority for the QA program, the QA function, and other WHC organizations participating in the RAMPAK program.

The Manager of the QA function reports to the Safety, Quality Assurance and Security Department Manager, who reports directly and independently to the Vice President and President of WHC. The responsibilities of the QA Manager include ensuring that WHC manuals and procedures provide complete and adequate instructions for the implementation of quality assurance requirements, and for ensuring sufficient reviews, inspections and audits are conducted by QA personnel to verify compliance to the procedures.

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The Procurement and Materials Management (PMM) of the Resources Allocation and Management (RAM) Department, Traffic group provides overall coordination of the WHC hazardous material packaging and shipping program via the WHC-CM-2-14, Hazardous Materials Packaging and Shipping Manual.

Packaging Development under Advanced Reactor Engineering Division is responsible for the onsite packaging designs and the Safety Analysis Reports for Packaging (SARP) which support the use of the packaging at Hanford.

The safe and efficient use of the RAMPAK is the responsibility of the packaging user.

- o The packaging owner's responsibilities include ensuring that packaging has valid inspection tags and for notifying QA and Non Destructive Examination (NDE) when an inspection is needed.
- o The cognizant engineer is responsible for the design of, and any design changes to, the RAMPAK.
- o The user is responsible for the proper use of the RAMPAK.

## **2. QUALITY ASSURANCE PROGRAM**

This Quality Assurance Program Plan (QAPP) specifies the appropriate requirements from the WHC-CM-4-2 for the RAMPAK program, and the attached QA Program Index (QAPI) identifies the procedures or documents which implement the specific QA requirements. Impact Levels are determined in accordance with MRP 5.43, "Impact Levels." All WHC organizations who participate in the RAMPAK program shall comply with this program as specified.

## **3. DESIGN CONTROL**

Engineering design activities for RAMPAK shall be accomplished in accordance with WHC-CM-6-1, Standard Engineering Practices and 49CFR173. The responsible design organization shall prepare specifications, instructions, and drawings as applicable to describe the associated activities. Packaging Development shall prepare the SARP.

Design reviews at WHC shall be in accordance with WHC-CM-6-1, Standard Engineering Practices, EP 4.1, "Design Verification Requirements." Supplier designs shall be approved by the responsible WHC design group prior to DOE review.

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A SARP shall be prepared and provide the analytical evaluation of the RAMPAK system in accordance with the DOE Order 1540.2 to demonstrate full compliance with the applicable regulations governing safe transport and/or storage or compliance through the use of appropriate administrative controls. If the container has an approved Certificate of Compliance (C of C) and all requirements and limitations of that C of C are met for Westinghouse's intended use of the container, then the SARP is acceptable without further comment. Waivers or exemptions to design requirements may be granted by the DOE in accordance with DOE Order 5480.3, provided the departure offers an equivalent degree of safety.

Interfaces shall be defined and controlled.

Changes to design documents shall be initiated, approved, and controlled through the use of the Engineering Change Notice (ECN) in accordance with WHC-CM-6-1, EP 2.2, "Engineering Document Change Control." The ECN is the approved method for making proposed changes to technical documents controlling the RAMPAK. Changes to the supplier design documents shall be transmitted via the ECN through the WHC review system for approval.

Software shall be developed and controlled in accordance with the design control section 3 of the Quality Assurance Manual. Additionally at WHC, the WHC Standard Engineering Practices, WHC-CM-6-1, EP 2.1, "Computer Software Configuration Management," shall be used to document software control. When testing is used for software design verification, the test plan and results shall be documented and included in the final documentation package.

#### **4. PROCUREMENT DOCUMENT CONTROL**

The procurement of packaging or associated packaging system components and services shall be controlled to assure conformance with specified RAMPAK requirements. The design basis and related requirements necessary to ensure adequate quality shall be included or referenced in documents for the procurement of items and services. Procurement documents shall require the supplier to have a QA program. The WHC technical and QA organizations shall verify the adequacy of the supplier QA program.

The design organization and QA shall review and approve manufacturing plans and indicate where independent source verifications are necessary.

Requirements for the contents of procurement documents, procurement planning, supplier selection, bid evaluation, supplier performance evaluation, control of supplier generated documents, control of changes in items or services, acceptance of items or services, and QA requirements are contained in WHC-CM-2-1, Procurement Manual and Procedures, and WHC-CM-2-2, Materials Management Manual while QA requirements for procurement are specified in paragraph 4 of WHC-CM-4-2..

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The procurement of Nuclear Regulatory Commission (NRC) licensed shipping containers shall be reviewed by the Procurement Review Board and approved by the responsible DOE-RL organization, prior to the award of the contract. Although other organizations may be represented, the Procurement Review Board shall consist of representatives from at least the following WHC organizations:

- o Engineering
- o Safety
- o QA
- o Radiological Assessment, Packaging and Shipping
- o Independent Technical Reviewer
- o Packaging and Shipping Subcouncil (Optional)
- o DOE-RL (Optional)

Changes to supplier design documents shall be processed in accordance with the methods specified in the supplier's QA program and approved by WHC.

## 5. INSTRUCTIONS, PROCEDURES, AND DRAWINGS

Packaging and shipping activities associated with RAMPAK shall be performed in accordance with methods prescribed by the WHC-CM-2-14, Hazardous Materials Packaging and Shipping Manual.

Westinghouse Hanford Company designs shall be translated into engineering drawings per WHC-CM-6-1, EP 1.3, "Preparation of Engineering Drawings." Supplier designs shall be prepared in accordance with methods specified in applicable standards and approved by WHC.

All fabrication of RAMPAK shall be in accordance with approved procedures as specified in the QA program.

All records prepared for the RAMPAK program which identify design criteria or fabrication methods shall be legible. Record retention shall comply with the requirements for records specified in paragraph 17 of this plan.

## 6.0 DOCUMENT CONTROL

Documents specifying quality requirements or prescribing activities affecting quality shall be controlled through procedures which provide the administrative directions for the preparation, issue, approval, and control of design documentation, including changes thereof.

Preparation and change of design documents at WHC shall be performed in accordance with WHC-CM-6-1.

Documents affecting quality shall be approved based on Impact Level definitions described by MRP 5.43. Impact of changes shall be evaluated by the cognizant design engineer against the original design base. Any change to an NRC or DOE licensed package shall be an impact level I change. Suppliers shall demonstrate that their internal document control system is in compliance with their approved QA program.

## 7. CONTROL OF PURCHASED ITEMS AND SERVICES

The procurement of items and services associated with the RAMPAK program shall be controlled through the issue of purchase orders in accordance with the requirements of the WHC-CM-2-1 and WHC-CM-2-2. The design, design base and other supporting requirements, necessary to assure adequate quality shall be included or referenced in the procurement package prepared for the purchase or containers or associated components.

The supplier shall be required to have a QA program consistent with the applicable requirements of the NQA-1. The supplier shall be responsible for all work conducted by sub-tier suppliers under their contract. The WHC cognizant engineer, or delegate, and supporting QA shall evaluate the supplier's QA program prior to purchase order placement.

Suppliers that are designated for design and/or fabrication services shall demonstrate their systems to be satisfactory for complying with the assigned specifications. Once approved, all changes in the design, including those resulting from anomalies or changes in the fabrication methods, shall be documented and approved by the WHC technical staff and QA organization through use of the ECN.

WHC QA shall provide independent inspection for all procured packaging.

## 8. IDENTIFICATION AND CONTROL OF ITEMS

The identification of materials or items ordered to specifications, standards, or codes must be maintained throughout fabrication, assembly, storage, and installation.

When traceability of material is required, identification shall be fixed to the resulting parts prior to subdivision of the material. Traceability must be maintained during fabrication. For Government Furnished Material (GFM), appropriate identification markings shall be applied to material and the supplier must demonstrate an independent method for tracking the documentation accompanying the material.

All RAMPAK shall be identified and controlled by the packaging owner to prevent incorrect use or the use of containers whose inspection tags have expired.

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Identification and control of items at WHC shall be in accordance with Section 8 of WHC-CM-4-2, Quality Assurance Manual. Identification and control of items by the suppliers shall be in accordance with their approved QA program.

## 9. CONTROL OF PROCESSES

Processes affecting the quality of items or services relating to RAMPAK shall be controlled. Special processes that control or verify quality, such as those used in impact tests, heat tests, welding, heat treating, NDE, submersion and puncture tests, must be performed by qualified personnel using qualified procedures in accordance with specified requirements.

Process control procedures shall be in compliance with design specifications, codes, or standards. Special processes at WHC shall be controlled by approved procedures in accordance with section 9 of WHC-CM-4-2, Quality Assurance Manual. Control procedures shall specify the preparatory steps, processing details, conditions to be maintained during each step, and the requirements for records.

Special processes performed by the supplier shall be in accordance with their approved internal procedures demonstrating appropriate documented control of personnel, equipment, and method.

The supplier's internal QA program shall assure that personnel, processes, and equipment are qualified in accordance with the purchase order documents prior to initiation of the fabrication. Objective evidence shall be provided by the supplier.

Welding at WHC shall be performed in accordance with drawings, WHC-CM-6-10, Welding Manual, and WHC-CM-6-26, Welding Procedures Specifications Manual. Non Destructive Examination shall be performed in accordance with WHC-CM-4-38, Nondestructive Examination Procedures.

Supplier welding requirements and performing procedures shall be prepared in accordance with methods specified in Requirements 5 and 9 of NQA-1 and approved by WHC prior to use.

## 10. INSPECTION

Inspections are examinations or measurements to verify whether an item or activity conforms to specified requirements. Inspections of RAMPAK shall be conducted by qualified QA personnel unless otherwise documented with the concurrence of QA. Inspections shall be performed in accordance with Inspection Plans. Inspection hold points and inspection criteria shall be included in fabrication travelers or work instruction.



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Westinghouse Hanford Company inspection personnel shall be qualified prior to the inspection in accordance with WHC-CM-4-2, QI 2-4, "Qualification of Quality Assurance Inspection and Test Personnel." The personnel providing the inspections for suppliers shall have demonstrated sufficient evidence that they are qualified for the inspections they are performing. Inspections shall be planned per documented methods and the results documented and provided to WHC.

Inspections at WHC shall be done in accordance with WHC-CM-4-2, QR 10. Inspections performed by the suppliers shall be done in accordance with their approved internal procedures.

All inspection results shall be documented and include the acceptance criteria. Records provided to WHC shall be legible and include:

- o Item inspected
- o Date of inspection
- o Inspector
- o Type of observation
- o Results or acceptability
- o Reference to information on action taken in connection with nonconformances

Quality Assurance has the responsibility for preparing and maintaining the inspection plans for each reusable Type A and Type B RAMPAK. Inspections shall be performed in accordance with WHC-CM-4-2, QI 13.2. When RAMPAK are out of use for periods exceeding 2 years, they will be put into a suspended category and inspected prior to use. The results of the inspection shall be documented and evaluated for acceptability and the proper tag attached to the RAMPAK.

## 11. TEST CONTROL

Tests required to verify conformance of an item or activity to specified requirements and to demonstrate satisfactory performance shall be planned and executed in accordance with WHC-CM-4-2, Section 11. Testing will meet the requirements of all applicable regulations.

Characteristics to be inspected and tested shall be specified in a test plan, as well as the methods to be used. The test plan must be approved by appropriate level of management and independent groups, including Safety and QA, to assure all requirements are fully met.

Test results shall be documented. The conformance of test results with acceptance criteria shall be evaluated. QA shall review and approve the test report to verify that the requirements for the test plan are fully addressed. The test results and report shall verify that the acceptance criteria specified in the test plan is met. Inspections for acceptance shall be performed by persons other than those who performed or directly supervised the work being inspected.

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Tests conducted by supplier shall be conducted in accordance with approved test plans and procedures. WHC shall approve test plans and verify that all requirements are addressed in the plan. Test reports shall reflect that the criteria are being met and must be approved by the supplier's QA.

Test records, test plans, and test reports containing results shall be maintained in accordance with paragraph 17 of this QAPP and include as a minimum:

- o Item tested
- o Date of test
- o Name of tester or data recorder
- o Type of observation
- o Results and acceptability

The test reports shall be included in the final data package.

**12. CONTROL OF MEASURING AND TEST EQUIPMENT**

Westinghouse Hanford Company control shall be in accordance with WHC-CM-4-2, QR 12, "Measuring and Test Equipment Control" and ANSI/IEEE 498. All measuring and test equipment (M&TE) used for accepting material or equipment, controlling special processes, or obtaining test data shall be calibrated and be traceable to nationally recognized standards. Calibrations shall be performed at planned intervals to provide confidence in the reliability of the M&TE. Records of the M&TE calibrations shall be maintained in accordance with WHC-CM-4-2, QI 12-2, "Measuring and Test Equipment Calibration Documentation" and paragraph 17 of this QAPP.

The supplier shall maintain control of M&TE in accordance with their approved internal procedures which have been verified by WHC QA as meeting NQA-1, BR 12.

**13. HANDLING, STORAGE, AND SHIPPING**

Packaging, handling, shipping and storage of packaging which are purchased, fabricated, shipped or stored by WHC shall be controlled to prevent damage or loss and to provide adequate safety of personnel involved. This shall be done in accordance with:

WHC-CM-1-3, Management Requirements and Procedures, MRP 5.20, "Packaging and Transportation of Hazardous Materials."

WHC-CM-2-14, Hazardous Material Packaging and Shipping.

WHC-CM-3-5, Records Management.

WHC-CM-4-2, Quality Assurance Manual, QR 13.0, "Handling, Storage and Shipping."

WHC-CM-6-4, Hanford Hoisting and Rigging Manual.

#### 14. INSPECTION, TEST, AND OPERATING STATUS

Quality Assurance shall:

- a. Maintain and publish the Radioactive Shipping Container Status Report, indicating the status for reusable WHC RAMPAKs.
- b. Affix tags to RAMPAKs to indicate the individual status of each serially numbered container.
- c. Inspect non-WHC-owned RAMPAK prior to use by WHC personnel per owner's inspection plan or per WHC generated inspection plans and appropriately tag or otherwise indicate the status of the packaging.

The owner of the RAMPAK shall:

- a. Not use any container with an expired inspection tag.
- b. Notify QA for inspection of the cask.
- c. Provide input to QA for the Radioactive Shipping Container Status Report.
- d. Insure that the RAMPAK is authorized and in suitable condition for use.
- e. Examine RAMPAK per 49 CFR 173.475.

#### 15. CONTROL OF NONCONFORMING ITEMS

Nonconformance reporting, control, and dispositioning shall be in accordance with WHC-CM-4-2, section 15, "Control of Nonconforming Items."

RAMPAKs that do not conform to specified requirements, or whose conformance is indeterminate, shall be controlled by the RAMPAK owner to prevent inadvertent use. Controls shall provide for identification, documentation, evaluation, segregation where practical, disposition of the nonconforming items, and notification to affected organizations.

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Identification of nonconforming packaging shall include hold tags placed in a conspicuous location appropriate to the RAMPAK size and weight. The hold tags are to be attached by WHC QA personnel, and detached by WHC QA personnel when the quality issue has been resolved and dispositioned. All dispositions shall be in accordance to WHC-CM-4-2, QI 15-1. DOE and NRC concurrence shall be obtained for dispositions which affect NRC license requirements.

**16. CORRECTIVE ACTION**

Conditions adverse to quality or significant conditions adverse to quality may be revealed by an audit, an unusual occurrence, a random observation during inspection, or from trend analysis of other reports (Nonconformance Report, etc.). The identification of unsatisfactory conditions, the cause of the condition, and the corrective action taken must be documented and appropriately reported. The reports must be verified by QA and appropriate levels of management for completeness.

Corrective action shall be in accordance with WHC-CM-4-2, QR 16, "Corrective Action", commensurate with the seriousness of the condition being corrected. Corrective action may also be identified in an unusual event report in accordance with MRP 5.14, "Event, Critique, and Unusual Occurrence Reporting." The effectiveness of corrective action must be demonstrated before a condition shall be considered corrected.

**17. RECORDS**

Records which furnish documentary evidence of quality for RAMPAKs shall be maintained in a manner consistent with the requirements and instructions of section 17 of WHC-CM-4-2. Records for the RAMPAK shall include a completed inspection plan and NDE Report for all RAMPAKs on which inspections are performed. The completed inspection report and NDE Reports shall be maintained by WHC QA with a copy submitted to the RAMPAK owner. Completed inspection reports and NDE reports shall be maintained for a minimum of six years as non-permanent records, except for the NRC and DOE licensed casks whose records are maintained for the life of the packaging. No further indexing or distribution shall be performed.

A copy of the specific license, C of C, or other approval of the packaging, drawings and other documents referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment shall be sent to Traffic per MRP 5.20, "Packaging and Transportation of Hazardous Materials."

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Testing records required by NRC and DOE requirements shall be identified and preserved for the life of the packaging and a record plan shall be established for all new NRC and DOE licenced packaging. These records will be maintained by the owner of the RAMPAK and all records will be transferred with any change of owners. These responsibilities lie with the organization responsible for the RAMPAK, with assistance of appropriate support organizations including Safety and QA.

Quality records may be either the originals or copies. Microform is acceptable, except for radiographs. Records must be legible, written in ink or typed, identifiable, and retrievable. Records must be protected from damage, deterioration, or loss. Lost or damaged records must be replaced, restored, or substituted promptly to the extent possible.

Records shall be readily retrievable. The time required for retrieval shall be commensurate with the urgency with which the record would be needed.

Correction to quality records shall be performed in accordance with WHC-CM-4-2, QR 17.0, paragraph 8.

The cognizant design organization is responsible for the preparation and retention of records and records plan until the responsible WHC owner becomes identified and accepts the records and responsibility for the records.

## **18. AUDITS**

Quality audits are conducted on both WHC project activities (internal audits) and suppliers (external audits) in accordance with WHC-CM-4-2, QR 18. Annual internal audits covering control of the RAMPAK and the shipping of radioactive material shall be performed by WHC QA.

Quality Assurance is responsible for conducting and scheduling quality audits. Audits are scheduled and performed to a prepared checklist and the results documented in a report to management. Follow up corrective actions are verified by the appropriate QA personnel.

## **4.0 REFERENCES**

1. DOE Order 1540.2, "Hazardous Material Packaging for Transportation-Administrative Procedures."
2. DOE Order 5480.3, "Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes," establishes the safety standards for hazardous materials packaging and transportation.
3. DOE-RL Order 5700.1A, "Quality Assurance," establishes quality assurance standards for Hanford operations.

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4. DOE Order 5700.6B, "Quality Assurance," establishes the quality assurance standards for DOE operations.
5. ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, American National Standard Institute/American Society of Mechanical Engineers Consensus Standard. This standard is endorsed for the Hanford Site.
6. ANSI/IEEE 498-1985, "Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities."
7. 49 CFR 173, "Shippers - General Requirements for Shipments and Packaging."
8. WHC-CM-1-2, Organization Charts and Charters.  
CH CC-5, "Safety and Environmental Advisory Council."
9. WHC-CM-1-3, Management Requirements and Procedures.  
MRP 5.2, "Quality Assurance."  
MRP 5.14, "Event, Critique, and Unusual Occurrence Reporting."  
MRP 5.20, "Packaging and Transportation of Hazardous Materials."  
MRP 5.43, "Impact Levels."
10. WHC-CM-2-1, Procurement Manual.
11. WHC-CM-2-2, Materials Management Manual.
12. WHC-CM-2-14, Hazardous Material Packaging and Shipping, has been established as the WHC authority for the packaging and shipment of radioactive and hazardous materials. This manual incorporates the requirements and controls specified in the following:  
10 CFR 71, "Packaging and Transportation of Radioactive Materials"  
49 CFR 178, "Shipping Container Specifications"  
49 CFR 171 - 49 CFR 173
13. WHC-CM-3-5, Records Management.
14. WHC-CM-4-2, Quality Assurance Manual, provides structure for the eighteen criteria contained in the NQA-1 consensus standard and supplements.
15. WHC-CM-4-38, Nondestructive Examination Procedures.
16. WHC-CM-6-1, Standard Engineering Practices, defines the requirements for preparing and controlling engineering documentation.

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17. WHC-CM-6-4, Hanford Hoisting and Rigging Manual.
18. WHC-CM-6-10, Welding Manual.
19. WHC-CM-6-26, Welding Procedures Manual.

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		WHC-CM-4-2 QR/QI	WHC-CM-1-3 MRP	Other WHC Manuals	Other
BR-1	ORGANIZATION	1.0	5.2		
1S-1	Multiple Organizations				
1S-1	Organizational Responsibilities				
BR-2	QUALITY ASSURANCE PROGRAM	2.0			DOE 5480.3 10CFR71
	QA Program Planning/Project Type Activities	2.1			
	QA Program Planning	2.2			
2S-4	QA Indoctrina- tion and Training	2.3			
2S-1	Qualification of QA Inspection and Test Personnel	2.4			
2S-3	Qualification of Audit Personnel	2.5			
2S-2	Management Assessments	2.7			

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NQA-1 Criteria	Title	Implementing Procedure(s)			
		WHC-CM-4-2 QR/QI	WHC-CM-1-3 MRP	Other WHC Manuals	Other
BR-3	DESIGN CONTROL	3.0	5.20	CM-6-1	49CFR173
3S-1	QA Verification and Evaluation of Design Activities	3.1		CM-6-1, EP 2.1 and 4.1	DOE 1540.2 DOE 5480.3
3S-1	Change Control			EP 2.2	
	Changes to Non-WHC Design Documents			EP 2.2	
BR-4	PROCUREMENT DOCUMENT CONTROL	4.0	5.20	CM-2-1, CM-2-2	
4S-1	Procurement Document Control	4.1			
	External Services Control	4.2			
BR-5	INSTRUCTIONS, PROCEDURES, AND DRAWINGS	5.0		CM-2-14 CM-6-1, EP 1.3	
	Preparation, Revision, and Control of QRs and QIs	5.1			
BR-6	DOCUMENT CONTROL	6.0	5.43	CM-6-1	
	QA Document Control	6.1			

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		WHC-CM-4-2 QR/QI	WHC-CM-1-3 MRP	Other WHC Manuals	Other
BR-1	CONTROL OF PURCHASED ITEMS AND SERVICES	7.0		CM-2-1, CM-2-2	
7S-1	Procurement Planning and Control	7.1			
7S-1	Supplier Qualification	7.2			
7S-1	Source Inspec- tion	7.3			
7S-1	Receiving Inspection	7.4			
BR-8	IDENTIFICATION AND CONTROL OF ITEMS	8.0			
8S-1	Material Identification and Control	8.1			
BR-9	CONTROL OF PROCESSES	9.0			
	Control of Nondestructive Examinations	9.1		CM-4-38	
9S-1	Control of Welding and Brazing	9.2		CM-6-10, CM-6-26	

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ASSURANCE PROGRAM PLAN**

**Table 1. Quality Assurance Program Index.**  
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NQA-1 Criteria	Title	Implementing Procedure(s)			
		WHC-CM-4-2 QR/QI	WHC-CM-1-3 MRP	Other WHC Manuals	Other
BR-10 10S-1	INSPECTION	10.0			
	Inspection Instruction for Operations, Maintenance, and Modifications	10.1			
	Inspection Instruction for Manufacturing and Fabrication	10.2			
	Surveillance	10.4			
	Selection and Interpretation of Readings from Variable- Reading Gages and Instruments	10.5			
BR-11	TEST CONTROL	11.0			
	Test Verifi- cation	11.1			
BR-12 12S-1	CONTROL OF MEASURING AND TEST EQUIPMENT	12.0			
	Acquisition and Calibration of Measuring and Test Equipment	12.1			ANSI/IEEE 498
	M&TE Calibration by Users				

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NQA-1 Criteria	Title	Implementing Procedure(s)			
		WHC-CM-4-2 QR/QI	WHC-CM-1-3 MRP	Other WHC Manuals	Other
BR-13	HANDLING, STORAGE, AND SHIPPING	13.0			
	Lifting	13.1		CM-6-4	
	Radioactive Materials Packaging	13.2			
BR-14	INSPECTION, TEST, AND OPERATING STATUS	14.0			
	Inspection and Test Status	14.1			
BR-15 15S-1	CONTROL OF NONCONFORMING ITEMS	15.0			
	Nonconforming Item Reporting	15.1	5.14		
	Nonconforming Item Control	15.2			
BR-16	CORRECTIVE ACTION	16.0			
	Analysis and Trending	16.1			
	Corrective Action Reporting	16.2			
BR-17	QUALITY ASSURANCE RECORDS	17.0	5.20		
	Records Control	17.1			

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NQA-1 Criteria	Title	Implementing Procedure(s)			
		WHC-CM-4-2 QR/QI	WHC-CM-1-3 MRP	Other WHC Manuals	Other
BR-18	AUDITS	18.0			DOE 5480.3
18S-1	Audit Programming and Schedule	18.1			
18S-1	Planning, Conducting, Reporting, and Follow-up of Quality Audits	18.2			

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The following abbreviations, acronyms, and definitions are provided to clarify material contained in this manual, and apply to the use of this manual only.

"A<sub>1</sub>". Means the maximum activity of special form radioactive material permitted in a Type A package (49 CFR 173.403(a)).

"A<sub>2</sub>". Means the maximum activity of radioactive material, other than special form of low specific activity radioactive material, permitted in a Type A package (49 CFR 173.403(b)).

A<sub>1</sub>A<sub>2</sub> System. A method for determining radioactive material quantity categories and proper packaging for each category.

Activity. The total amount of radioactivity in a shipment expressed in the traditional units of curies, e.g., Ci, mCi, uCi, etc., or the International System (SI) units of becquerels (Bq).

ALAP. Acronym for As Low As Practicable.

ALARA. Acronym for As Low As Reasonably Achievable.

ALO-TSD. Acronym for Albuquerque Operations Office - Transportation Safeguards Division.

Alpha Particle ( $\alpha$ ). A particle identical to the helium atom nucleus emitted by some radionuclides called alpha emitters. Each alpha particle consists of two protons and two neutrons and has two positive charges.

Beta Particle ( $\beta$ ). A particle with same mass and size of an electron with either a negative (electron) or a positive (positron) charge emitted from an atomic nucleus in the disintegration process.

Bill of Lading. A non-negotiable document by which a carrier acknowledges receipt of freight and contracts for its movement.

Carrier. An individual or corporation engaged in the business of transporting goods or passengers by land, sea or air.

Categories I, II, III. Special Nuclear Materials (SNM) are divided by weight (grams) into three major categories with specific physical protection requirements for each. See DOE Order 5632.2A, "Physical Protection of Special Nuclear Materials and Vital Equipment." Category IV is an accountability categorization for source and other nuclear materials.

CFR. Acronym for Code of Regulations; contains a codification of documents of general applicability and future effect. Published by the Office of the Federal Register as a special edition of the Federal Register.

COC. Acronym for Certificate of Compliance. A permit to use a specific container issued by DOE or NRC.

Combustible Liquid. Any liquid with a flash point from 100 to 200 F or as measured by the tests specified in 49 CFR 173.115, except any mixture having one or more components with a flash point of 200 F or higher, that makes up at least 99% of the total volume of the mixture (49 CFR 173.115(b)).

Compressed Gas. Any material or mixture having in the container a pressure exceeding 40 psia at 70 F, or a pressure exceeding 104 psia at 130 F, or any liquid flammable material having a vapor pressure exceeding 40 psia at 100 F (49 CFR 173.300(a)).

Consignee. One to whom a shipment is addressed; the receiver

Consignor. One initiating a shipment; the shipper

Consumer Commodity. A material that is packaged or distributed in a form intended and suitable for sale through retail sales agencies or for consumption by individuals for purposes of personal care or household use. This term also includes drugs and medicines (49 CFR 171.8).

Controlled Vehicle. A vehicle having fixed radioactive contamination and a low potential for personnel contamination.

Convoy. Personnel and equipment designated to accompany a shipment while in transit.

Corrosive Material. Any liquid or solid that causes destruction of human skin tissue, or a liquid that has a severe corrosion rate on steel. (See 49 CFR 173.240(a) and (b) for details.)

CPS. Acronym for Criticality Prevention Specification.

CSAR. Acronym for Criticality Safety Analysis Report.

CSS. Acronym for Criticality Safety Specification.

Curie (Ci). The international curie is a unit of radioactivity equal to  $3.7 \times 10^{10}$  disintegrations per second; also equal to  $3.7 \times 10^{10}$  becquerels (Bq).

DOE. Acronym for U.S. Department of Energy. A regulatory agency of the Federal Government that has jurisdiction over certain energy and defense waste programs and that establishes packaging requirements for radioactive materials in support of these programs.

DOE-RL. Acronym for U.S. Department of Energy. Richland Operations Office

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DOT. Acronym for U.S. Department of Transportation. A regulatory agency of the Federal Government that has jurisdiction over the safe transport of materials moving in interstate commerce. The regulations covering the transportation of hazardous materials are found in 49 CFR Parts 171-179.

Emergency. Any serious event that causes a delay in transporting a package to its destination (e.g., vehicle breakdown, collision, highway obstruction, etc.).

EPA. Acronym for U.S. Environmental Protection Agency.

Etiologic Agent. A viable micro-organism or its toxin which causes or may cause human disease (49 CFR 173.386). Refer to the U.S. Department of Health, Education and Welfare Regulations, 42 CFR 72.25(c), for list of agents.

Exclusive Use. A shipment where the consignor reserves a vehicle exclusively for his use and where all initial, intermediate, and final loading and unloading is carried out under the direction of the consignor, consignee, or a designated agent.

Explosive. Any chemical compound, mixture, or device, the primary purpose of which is to function by explosion with substantial instantaneous release of gas and heat (49 CFR 173.50).

Fissile Class I. Shipments of fissile material in packages that may be transported in unlimited numbers, in any arrangement, and without any nuclear criticality safety array controls during transportation. A transport index is not assigned to Fissile Class I packages for purposes of nuclear safety control (49 CFR 173.455). However, the external radiation levels may require assignment of a transport index (49 CFR 173.403(bb)).

Fissile Class II. Shipments of fissile material in packages that may be transported together in any arrangement but in numbers that do not exceed an aggregate transport index of 50. For purposes of nuclear safety control, the transport index of an individual package shall not be less than 0.1, nor more than 10, and shall be the higher of the two values required by either external radiation levels or criticality prevention. Such shipment requires no nuclear safety control by the shipper during transportation (49 CFR 173.455).

Fissile Class III. Shipments of fissile material in packages that do not qualify as Fissile Class I or Fissile Class II packages. Nuclear safety control and radiation control during transportation are provided by special arrangement (e.g., exclusive use) between the shipper and the carrier (49 CFR 173.455).

Fissile Exempt. The quantity or concentration of fissile material exempt from DOT fissile material packaging requirements (49 CFR 173.453).

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Fissile Material. Any material containing  $^{238}\text{Pu}$ ,  $^{239}\text{Pu}$ ,  $^{241}\text{Pu}$ ,  $^{233}\text{U}$ , or  $^{235}\text{U}$  (49 CFR 173.403(j)). Neither natural nor depleted uranium are fissile material.

Flammable Gas. Any compressed gas meeting requirements for lower flammability limit, flammability limit range, flame projection, or flame propagation criteria as specified in 49 CFR 173.300(b).

Flammable Liquid. Any liquid with a flash point less than 100° F as measured by the tests specified in 49 CFR 173.115, with the following exceptions: (1) a flammable liquid with a vapor pressure greater than 40 psia at 100° F, as defined in 49 CFR 173.300; (2) any mixture having one component or more with a flash point of 100° F or higher that makes up at least 99% of the total volume of the mixture; and (3) a water-alcohol solution containing 24% or less alcohol by volume if the remainder of the solution does not meet the definition of a hazardous material contained in 49 CFR.

Flash Point. The minimum temperature at which a substance gives off flammable vapors which in the presence of air and in contact with spark or flame, will ignite (49 CFR 173.115).

Forbidden. Hazardous material that may not be offered or accepted for transportation (49 CFR 172.101(d)).

Gamma Ray ( $\gamma$ ). An electromagnetic radiation emitted by the nuclei of certain radioactive substances during decay, similar in nature to X-Rays.

HM. Acronym for Hazardous Material. A substance or material that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported and that has been so designated by the DOT (49 CFR 171.8).

HMSR. Acronym for Hazardous Material Shipment Record. A form recording data and documenting the shipment of (non-radioactive) hazardous material. This record when signed by an authorized individual certifies that the material has been properly prepared for shipment.

HRCQ. Acronym for Highway Route Controlled Quantity. A packaged quantity of radioactive material which when shipped offsite requires special routing, labeling, and placarding, in addition to other special requirements (49 CFR 173.403(l)).

Hazardous Substance. A quantity of a material offered for transportation that equals or exceeds the reportable quantity (RQ) specified for the material in EPA regulations (see 49 CFR 171.8 for specific criteria).

HW. Acronym for Hazardous Waste. A material subject to the hazardous waste manifest requirements of the EPA (see 49 CFR 171.8).

IAEA. Acronym for International Atomic Energy Agency. An agency of the United Nations that provides regulations covering the shipment of fissile and other radioactive materials between countries. The Agency regulations are contained in IAEA pamphlet Safety Series Number 6, "Regulations for the Safe Transport of Radioactive Materials"; and Safety Series Number 37, "Advisory Materials for the Application of IAEA Transport Regulations".

International System (SI) of Units. An extended and improved form of the metric system being increasingly incorporated into general usage. A comparison of the appropriate traditional and SI units for radioactivity is given here.

<u>Quantity</u>	<u>Traditional Unit</u>	<u>SI Unit</u>	<u>Relationship of Traditional and SI Units</u>
Activity	Curie (Ci)	becquerel (Bq)	$1 \text{ Bq} = 2.7 \times 10^{-11} \text{ Ci}$
	$2.2 \times 10^{12} \text{ dpm}$	1 dps	$1 \text{ curie} = 3.7 \times 10^{10} \text{ Bq}$ 37 GBq, 0.037 TBq
Absorbed Dose	rad	gray (Gy)	$1 \text{ Gy} = 100 \text{ rad}$ $1 \text{ rad} = 10^{-2} \text{ Gy}$
	rem	sievert (Sv)	$1 \text{ Sv} = 100 \text{ rem}$ $1 \text{ rem} = 10^{-2} \text{ Sv}$

Since a Bq is extremely small, use:

Kilobecquerel	$1 \text{ kBq} = 10^3 \text{ Bq}$
Megabecquerel	$1 \text{ MBq} = 10^6 \text{ Bq}$
Gigabecquerel	$1 \text{ GBq} = 10^9 \text{ Bq}$
Terabecquerel	$1 \text{ TBq} = 10^{12} \text{ Bq}$

Irritating Material. A liquid or solid substance which upon contact with fire or exposure to air gives off dangerous or intensely irritating fumes, but not including any poisonous material, Class A (see 49 CFR 173.381).

Limited Quantity. The maximum amount of hazardous material, as specified in those sections of 49 CFR Part 173 applicable to the particular hazard class, for which there are specific exceptions from the requirements of the subchapter.

LSA. Acronym for Low Specific Activity Radioactive Material. see 49 CFR 173.403(n).

MFP. Acronym for Mixed Fission Products for which there is no specific definition. Generally includes mixtures of isotopes ranging in mass numbers from 70 to 162 depending on their half lives and time since formation in the fission process.

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Nonflammable Gas. Any compressed gas other than a flammable compressed gas (49 CFR 173.300).

Normal Form Radioactive Material. See 49 CFR 173.403(s).

N.O.S.. Acronym for not otherwise specified.

NRC. Acronym in this manual, for U.S. Nuclear Regulatory Commission. A regulatory agency of the U.S. Government. It has, among other matters, jurisdiction over licensee packaging requirements for radioactive materials, some of which are adopted by DOE. This acronym is also used by the DOT in 49 CFR to mean non reuseable container.

Nuclear Safety and Criticality Prevention. Are used synonymously; the terms refer to the limits established to prevent nuclear chain reactions in a nonreactor environment.

Offsite Shipment. The movement of material from the packaging facility of any of the following onsite contractors to any offsite receiver:

Battelle Pacific Northwest Laboratory

Westinghouse Hanford Company

Kaiser Engineers Hanford Company

OHP. Acronym for Operational Health Physics.

Onsite Radioactive Shipment Record. A form recording data and documenting the onsite shipment of radioactive materials. This record when signed by an authorized individual certifies that the material has been properly prepared for shipment. The acronym for Onsite Radioactive Shipment Record is RSR.

Onsite Shipment. A movement of material within the confines of the Hanford Site between DOE-RL contractor facilities or between or within security areas. (See also Shipment)

Organic Peroxide. An organic compound containing the bivalent -O-O- structure and which may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals (see 49 CFR 173.151a for exceptions and details).

ORM. Acronym for Other Regulated Materials. Any material that does not meet the definition of another hazard class, but may pose an unreasonable risk to health and safety when transported and is specified in 49 CFR 172.101 as an ORM material or that possesses one or more of the characteristics described in ORM-A through E (see 49 CFR 173.500).

ORSR. Acronym for Offsite Radioactive Shipment Record. A form recording data and documenting the offsite shipment of radioactive material. This form when signed by an authorized individual certifies that the material has been properly prepared for shipment.

Oxidizer. A substance such as chlorate, permanganate, inorganic peroxide, nitro carbo nitrate, or a nitrate that yields oxygen readily to stimulate the combustion of organic matter (49 CFR 173.151).

Package. The packaging and its contents as presented for transport.

Packager. The contractor responsible for the preparation of a package of hazardous material for shipment, including radioactive material.

Packaging. The assembly of containers, insulation, shielding, and other components as described in the package specification or COC.

Placard. A square-on-point sign measuring 10 3/4 in. per side; e.g., a radioactive placard has "Radioactive" in black letters on a yellow and white background (see 49 CFR Part 172, Subpart F, for details). This placard is displayed on the front, back, and sides of each dedicated onsite vehicle carrying radioactive material and each offsite vehicle carrying radioactive material which requires a Yellow III label or LSA full load. A recent change in the regulations governing offsite movement of an HRCQ of radioactive materials requires the radioactive warning placard be placed on a square background as described in 49 CFR 172.527. Placards are carried in store stock under the following identification:

- o Truck 37-6775-390
- o Rail 37-6775-300

Poison A. Extremely Dangerous Poisons, Class A. Poisonous gases or liquids of such nature that a very small amount of the gas or vapor of the liquid, mixed with air is dangerous to life (49 CFR 173.326).

Poison B. Less Dangerous Poisons. Substances, liquids, or solids (including pastes and semi-solids), other than Class A or irritating materials, which are known to be so toxic to man as to afford a hazard to health during transportation or are presumed to be toxic to man (49 CFR 173.343).

Procedure. Written instructions that specify or describe how an activity is to be performed. It may include methods to be employed, equipment or materials to be used, and sequence of operations.

Proper Shipping Name. Name of the hazardous material as shown in Roman print (not italics) in 49 CFR 172.101, Hazardous Materials Table.

PSAA. Acronym for Packaging and Shipping Approval Authority.

PSSC. Acronym for Packaging and Shipping Sub Council.

Pyrophoric, Liquid. Any liquid that ignites spontaneously in dry or moist air at or below 130° F (49 CFR 173.115).

QA. Acronym for Quality Assurance.

QC. Acronym for Quality Control.

Rad. A unit of absorbed radiation dose, which approximates 0.01 grays (Gy) or 0.01 joule/kilogram (J/kg).

Radioactive Material. For offsite shipments, any material or combination of materials that spontaneously emits ionizing radiation and has a specific activity greater than 0.002 microcurie per gram (Ci/g) or 74 Bq/g (49 CFR 173.403(y)).

For onsite shipments items, materials, or equipment which meet any of the following criteria:

Specific activity exceeds 2 nCi/g,

Alpha activity exceeds 60 pCi/g,

Fixed or smearable radioactive contamination that is detectable with standard portable survey instruments,

Activity exceeds that for exempt quantities (listed in Appendix F, WHC-CM-4-10), or

The item is classified as a radioactive source.

RAM. Acronym for Resource, Allocation & Management Department. RAM shall not be used in this manual to denote radioactive material.

Regulated Vehicle. See Controlled Vehicle.

REM. Stands for "roentgen equivalent man"; it is the quantity of any type radiation having the same effect on the body as one rad of x or gamma radiation. One REM approximates 0.01 sievert (Sv) or 0.01 J/kg.

Removable Radioactive Contamination. Radioactive contamination that can be readily removed in measurable quantities by wiping the contaminated surface with an absorbent material. (See 49 CFR 173.443).

RM. Acronym for Radiation Monitoring.

RPT. Acronym for Radiation Protection Technologist.

RQ. Acronym for Reportable Quantity.

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RSR. Acronym for Onsite Radioactive Shipment Record.

RWP. Acronym for Radiation Work Procedure.

SARP. Acronym for Safety Analysis Report for Packaging.

Seal (Type E). A numbered tamper-indicating seal, that is destroyed in disassembly.

Shipment. One or more packages of hazardous material to be transported to a consignee at one time, and may be in one or more vehicles. Onsite Shipments are classified as interarea (between areas) and intra area (within an area) movements. These shipments are movements that cause the material to change areas or building residences or custodianship. (See also User Movement)

Shipment, International. A shipment consigned to any foreign country.

Shipment, Large. A shipment weighing 5,000 lb or more.

Shipment, Small. A shipment weighing less than 5,000 lb.

Shipper. WHC is the shipper for DOE-RL of all hazardous and radioactive materials moved offsite by DOE-RL contractors in connection with contract-related work, including materials moved by DOE courier. (See RL 5480.1A, Chapter III).

SNM. Acronym for Special Nuclear Material.

Solid, flammable. Any solid material, other than an explosive, that is liable to cause fires through friction, absorption of moisture, spontaneous chemical changes, retained heat from manufacturing or processing, or that can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation hazard (49 CFR 173.150).

Special Form Radioactive Material. See 49 CFR 173.403(z) and 173.469.

Special Nuclear Material. Any quantity of plutonium,  $^{233}\text{U}$ , or uranium-enriched in the  $^{235}\text{U}$  isotope. For more details, see DOE Order 5632.2.

Spontaneously Combustible Material (solid). Any solid substance (including sludges and pastes) that may undergo spontaneous heating or self-ignition under conditions normally incident to transportation of that may upon contact with the atmosphere undergo an increase in temperature and ignite (49 CFR 171.8 and 173.150).

SST. Acronym for Safe Secure Trailer operated by ALO-TSD.

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Transport Index (TI). The dimensionless number (rounded up to the first decimal place) placed on the label of a RAM package to designate the degree of control to be exercised by the carrier during transportation (See 49 CFR 173.403(bb)). The TI is used as a guide to control placement of radioactive material in a vehicle or in segregated batches for storage to reduce radiation exposure to people and/or to prevent the initiation of a criticality.

The shipper determines the TI as follows: For radioactive material packages of non-fissile material, i.e., those containing <15 g fissile material and/or any amount of other radionuclides the TI is simply the maximum radiation dose rate in m rem/hr measured at one meter (3.3 ft) from the surface of the package. For packages of fissile material the minimum TI is determined by a criticality safety analysis. This analysis evaluates the container with various fissile material loadings and determines the number of containers that may be shipped together on a single vehicle without causing a criticality. Since any one vehicle may transport no more than 50 transport index units at a time, the number 50 is divided by the maximum number of containers allowed per vehicle to determine the minimum TI assigned to each container. For example, criticality safety analysis for the Model 60 shipping container allows 125 Model 60s for a loading of 120 FFTF fuel pins each, to be shipped together at one time. The minimum TI per container then is  $50/125 = 0.4$  TI units. Note, this is the minimum TI for this specific loading. As is often the case, however, we find the radiation dose rate from combined alpha and neutrons for one of these containers with this loading exceeds 0.4 m rem/hr at one meter. In this case, the higher number, the measured dose rate, will become the TI. Do not add the 0.4 from criticality analysis and the dose rate reading to obtain the TI. The TI is only the higher value of the two.

TSDF. Acronym for Treatment Storage Disposal Facility.

Type A Packaging. See 49 CFR 173.403(gg).

Type A Quantity. See 49 CFR 173.431(a).

Type B Packaging. See 49 CFR 173.403(hh).

Type B Quantity. See 49 CFR 173.431(b).

User Movement. The transport of hazardous or radioactive material by an employee who will retain direct custody and use the material in performance of his onsite duties. As examples a painter moving a 5 gallon bucket of flammable paint from the storeroom or warehouse to job site where the paint is consumed; or a Radiation Protection Technician moving a radioactive source from building to building to check or calibrate radiation detection equipment.



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Water Reactive Material (solid). Any solid substance (including sludges and pastes) which, by interaction with water, is likely to become spontaneously flammable or to give off flammable or toxic gases in dangerous quantities (49 CFR 171.8 and 173.150).

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